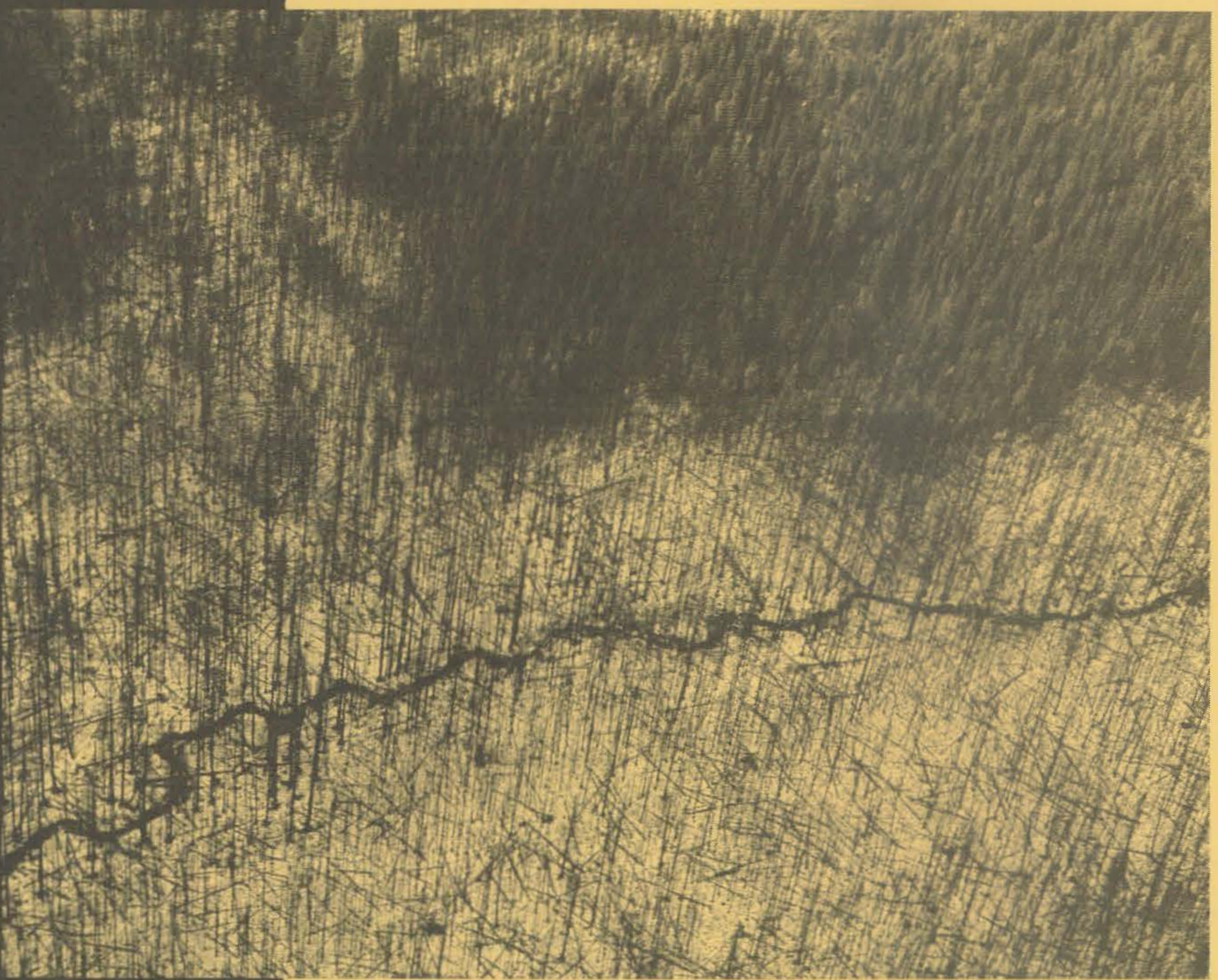
United States
Department of
Agriculture

Forest
Service

Bitterroot
National
Forest

# Bitterroot Fires 2000

## An Assessment of Post-Fire Conditions With Recovery Recommendations



December, 2000

# BITTERROOT FIRES 2000:
## *AN ASSESSMENT OF RESOURCES AND HUMAN USES WITH RECOVERY RECOMMENDATIONS*

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Cover photo: Bugle Creek in the Upper East Fork River Drainage, September, 2000. Photo by: Garry Seloske

## I. Introduction

The Bitterroot National Forest experienced a fire event of historic proportions in the year 2000. Significant new landscape patterns resulted that will affect the people and resources in this ecosystem for decades to come. The fires have resulted in many effects and outcomes; some currently known and others that will only be known with time.

The fires present a rather formidable long-term recovery workload for the Bitterroot NF. Many questions now face the affected communities, interested citizens, and the Forest. What work should be conducted in response to the fires? Where and when should this work take place? How will the work be accomplished?

Fire recovery work is needed in both the short and long terms. Critical short-term recovery work has already been accomplished on much of the severely burned land. The Forest has made significant progress on an extensive program of Burned Area Emergency Rehabilitation (BAER) work, but additional work remains to be done next year and perhaps in years to follow. The BAER work includes many actions to reduce immediate hazards, stabilize soils, and protect watersheds.

Concurrent with the recent BAER work, the Forest has assigned an interdisciplinary team to conduct an assessment of post-fire resource conditions on and near National Forest lands and to gather public input on priority recovery needs. This report strives to fulfill the following three objectives:

- <u>Describe the status of resources and human uses that we currently know.</u> This evaluation focuses on what we believe to be the most relevant issues. Reference (historic), pre-fire, and post-fire resource conditions are discussed. Due to time limitations, we limited the assessment to include existing information and did not collect additional data.

- <u>Identify social and resource risks, recovery needs, and resource improvement opportunities.</u> To date, we've hosted twelve community and Forest Service listening and learning sessions to better define what issues we should evaluate, provide an opportunity for people to express their preferences and concerns regarding recovery work, and to share information that the assessment team has assembled.

- <u>Present a three to five year program of recovery work, with priorities.</u> These recommendations incorporate Bitterroot Forest Plan goals and objectives and are designed to meet biophysical and social needs in the wake of the 2000 fire event.

This assessment focuses on lands burned during the summer of 2000 and also on unburned lands in the wildland-urban interface. Much of this assessment focuses on conditions and needs of lands directly affected by the fires of 2000. The fires have also caused a heightened awareness of the risks to those who have homes and property in the forested environment adjoining the National Forest. In response to this heightened awareness, this assessment also evaluates fuel conditions and fire risks in the wildland urban interface to determine priority needs and actions. This information will be used to develop a defensible communities strategy.

This assessment follows procedures specified in "Ecosystem Assessment at the Watershed Scale; Federal Guide for Watershed Analysis, 1995". It evaluates current resources in their historic context and in view of current legal and managerial direction. This document does not make decisions. It identifies management options in the wake of the 2000 fire event and recommends a program of recovery work in the next few years. The recommendations are based on current information and public input during the fall, 2000.

The assessment was conducted at various scales. Some resource conditions are addressed at the Regional or Basin scale. Some conditions are evaluated for all burned areas and interface lands Forest-wide. Other conditions are discussed for specific geographic areas defined by fire, watershed boundaries, or community boundaries. The following six geographic areas are evaluated in this report:

- Blodgett Fire (Canyon, Blodgett and Mill Creek drainages and the Bitterroot Face)
- Selway-Salmon Rivers Fires (Wilderness Fire Complex)
- West Fork Bitterroot Fires (Little Blue, Razor, Taylor Springs, and Fat Fires)
- East Fork Bitterroot Fires (A portion of the Valley Complex and Mussigbrod Fire in the East Fork drainage)
- Skalkaho – Rye Fires (A portion of the Valley Complex and the Skalkaho Complex, including Skalkaho, Sleeping Child, and Rye Creek drainages)
- Unburned Wildland – Urban Interface Lands

This assessment is organized in five sections. Section 2 provides a brief overview of the extent of the 2000 fire event on the Bitterroot National Forest. Section 3 provides a summary of the public comments and opinions expressed during the series of Community Opportunity Meetings held during the fall, 2000. Section 4 provides more detailed analysis of resource conditions and effects for many resource topics. Section 5 identifies priority recovery work for the next few years.

## 2. The Extent of the 2000 Fires on the Bitterroot National Forest

Many areas of western Montana and central Idaho were visited by fire in 2000. Fire activity was prominent in the Northern Rockies and all of the forests adjoining the Bitterroot National Forest. Of particular note are the large fires to the south and southwest on the Salmon-Challis and Payette National Forests, to the east on the Beaverhead-Deerlodge National Forest, and to the north and northeast on the Lolo National Forest. For more information providing a regional context for the 2000 fires, refer to "A Preliminary Assessment of the Extent and Effects of the 2000 Fires" (USDA Forest Service, Northern and Intermountain Region, November, 2000).

This section of the assessment presents information on where fires burned on the Bitterroot National Forest and summarizes some basic data on fire acreages and burn severity.

Map 1 shows the extent of fires on the Bitterroot National Forest in 2000.

Maps 2 through 6 display fire extent and three classes of burn severity for the five geographic areas discussed in this assessment:

- the Blodgett Fire, Map 2
- the Selway-Salmon Fires, Map 3
- the West Fork Fires, Map 4
- the East Fork Fires, Map 5
- the Skalkaho/Rye Fires, Map 6

Burn severity is classified according to impacts on soils. The "Soil Integrity" report in Section 4.1 of this assessment describes the three burn severity classes in detail. In general, in areas mapped as moderate and high severity, most conifer trees and other non-sprouting plants were lethally scorched.

Map 7 shows the wildland urban interface lands on the Bitterroot National Forest. This area is defined as "Fire Management Zone 1" from the Forest's Fires Management Action Plan. For more discussion of this zone and its definition, refer to the "Wildland Urban Interface" report in Section 4.9.

Burned Areas Emergency Response (BAER) teams mapped burn severity in areas visited by fire. Burn severity maps were overlaid with different boundaries to derive statistics on the extent of fires on the Bitterroot National Forest in 2000 (Bitterroot National Forest GIS data base). Table 1 displays the percent of Bitterroot National Forest Land burned by severity class and also by land area in Montana and Idaho.

Map 1: Bitterroot National Forest Fires 2000

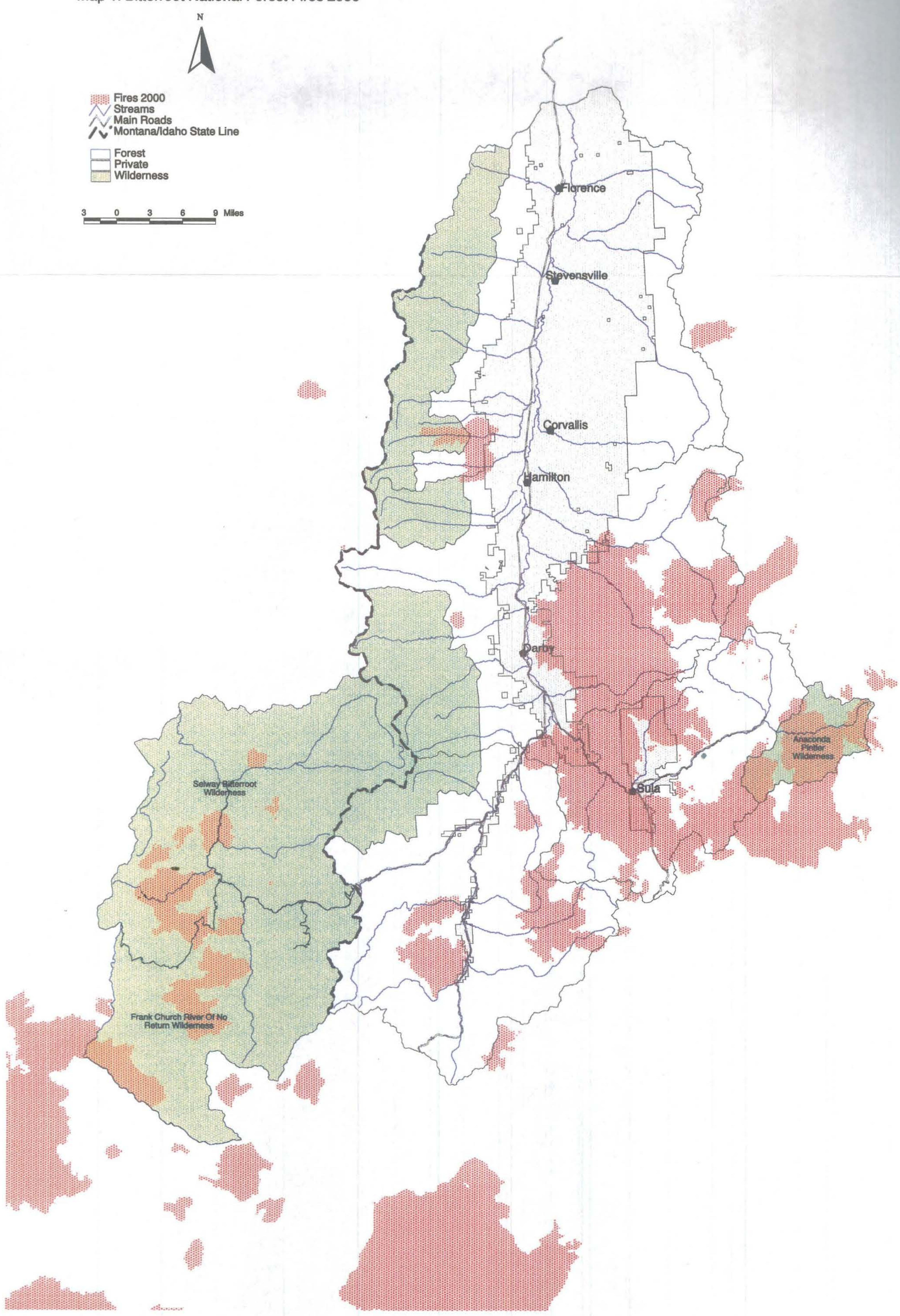


**Table 1:** Burn severity statistics for the entire Bitterroot National Forest (BNF), Bitterroot National Forest lands in Montana (MT), Idaho (ID), and on State and private land in Ravalli County, Montana (numbers rounded to nearest hundred acres).

| **Land Owner-ship** | **High Severity Burn** | | **Moderate Severity Burn** | | **Low Severity Burn** | | **Total Burned Area** | |
|---|---|---|---|---|---|---|---|---|
| | Acres | Percent | Acres | Percent | Acres | Percent | Acres | Percent |
| BNF - All | 85,200 | 5 | 55,900 | 4 | 165,900 | 11 | 307,000 | 20 |
| BNF- ID*(1)* | 7,600 | 2 | 9,200 | 2 | 46,700 | 10 | 63,500 | 14 |
| BNF - MT | 77,600 | 7 | 46,700 | 4 | 119,200 | 11 | 243,500 | 22 |
| State and Private | 15,800 | 32 | 15,600 | 32 | 17,600 | 36 | 49,000 | unest |
| Total All Ownership | 101,000 | 28 | 71,500 | 20 | 183,500 | 52 | 356,000 | unest |

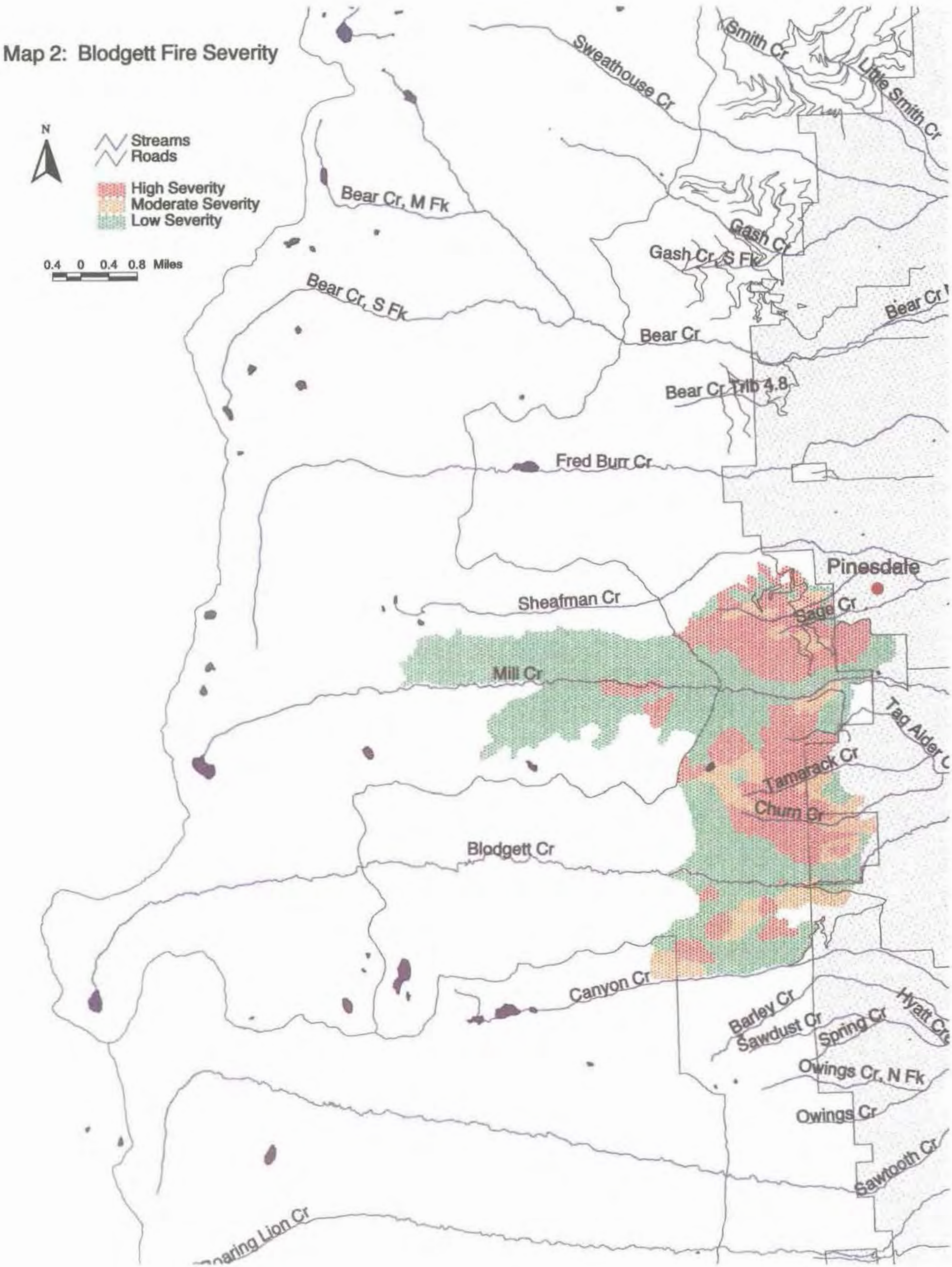
*(1)* The vast majority of BNF land in Idaho is designated Wilderness.

Table 2 summarizes burned area acreages by burn severity class for different categories of land in the Montana portion of the Bitterroot National Forest.

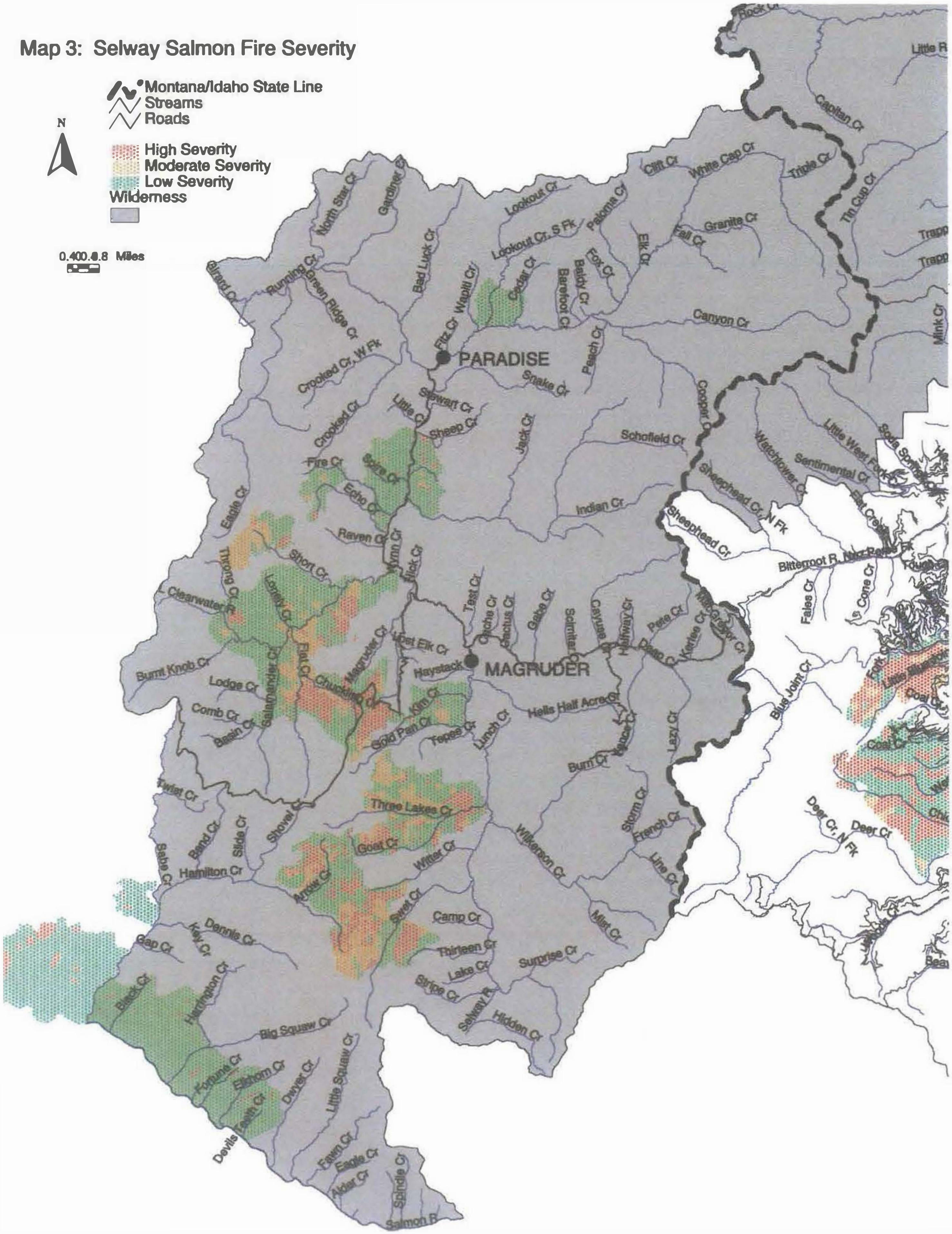
<u>**Table 2:**</u> Burn severity statistics for various categories of land for the Montana portions of the Bitterroot National Forest (numbers rounded to nearest hundred acres).

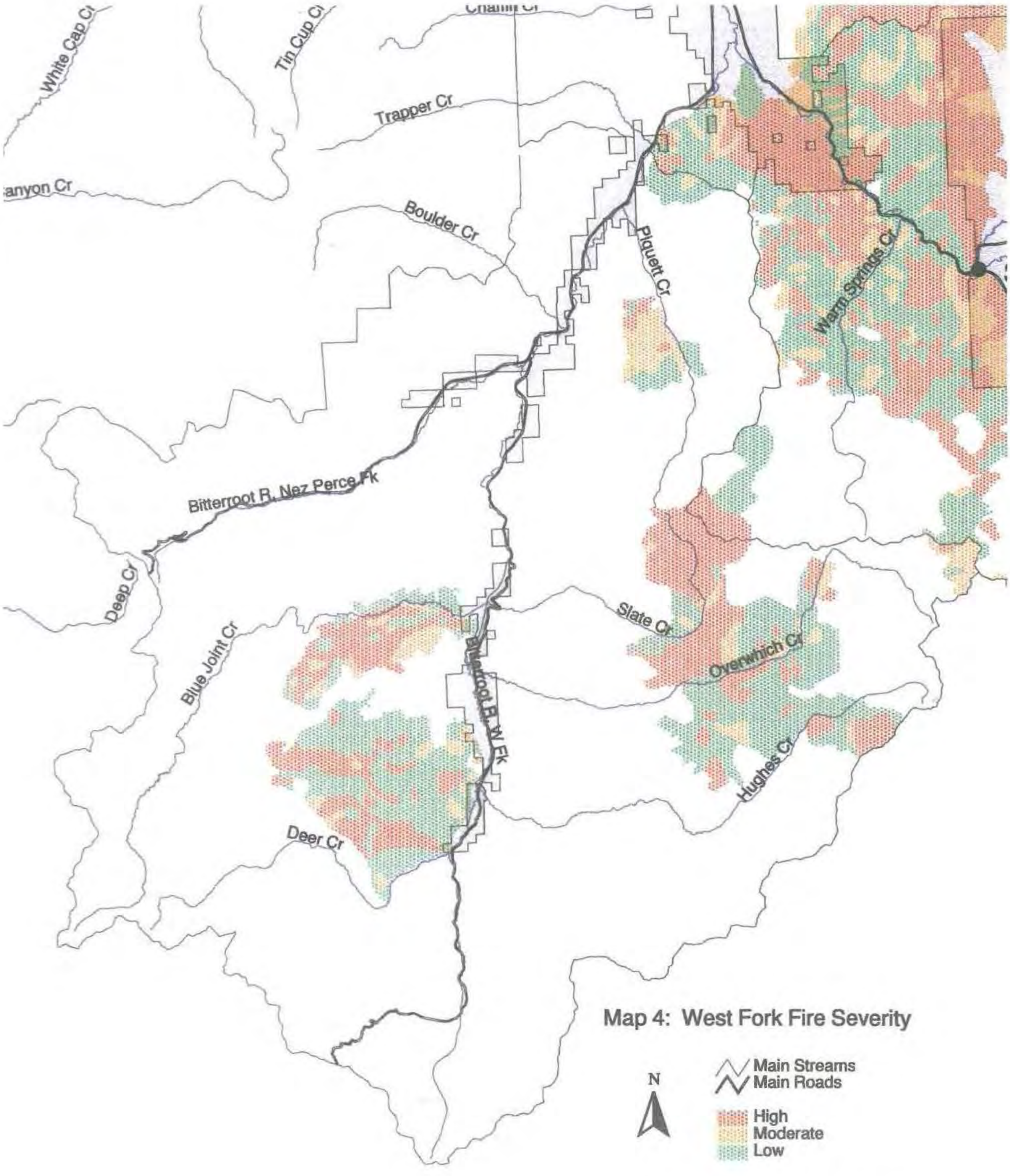
| Land Category | High Severity | | Moderate Severity | | Low Severity | | Total Burned | |
|---|---|---|---|---|---|---|---|---|
| | Acres | Percent | Acres | 1 | Acres | Percent | Acres | Percent |
| Wilderness | 11,700 | 4 | 6,100 | 2 | 14,000 | 5 | 31,800 | 11 |
| Selway-Bitterroot Wilderness | 200 | 0 | 100 | 0 | 3,200 | 1 | 3,500 | 1 |
| Anaconda Pintler Wilderness | 11,500 | 28 | 6,000 | 15 | 10,800 | 26 | 28,300 | 69 |
| Non-Wilderness | 65,900 | 8 | 40,600 | 5 | 105,200 | 13 | 211,700 | 26 |
| Commercial Forest Land *(2)* | 45,600 | 9 | 31,200 | 7 | 72,700 | 15 | 149,500 | 31 |
| Roaded Land | *(2)* 36,400 | 9 | 25,400 | 6 | 59,500 | 14 | 122,400 | 29 |
| Roadless Land | 29,500 | 7 | 14,200 | 4 | 45,600 | 11 | 89,300 | 22 |

*(2)* Commercial Forest Land includes all lands in the Forest Plan Management Areas 1, 2, and 3.


Map 2: Blodgett Fire Severity
N
Streams
Roads
High Severity
Moderate Severity
Low Severity
0.4 0 0.4 0.8 Miles
Smith Cr
Little Smith Cr
Sweathouse Cr
Bear Cr, M Fk
Gash Cr
Gash Cr, S Fk
Bear Cr, S Fk
Bear Cr
Bear Cr Trib 4.8
Fred Burr Cr
Pinesdale
Sheafman Cr
Sage Cr
Mill Cr
Tag Alder
Tamarack Cr
Churn Cr
Blodgett Cr
Canyon Cr
Barley Cr
Sawdust Cr
Spring Cr
Hyatt Cr
Owings Cr, N Fk
Owings Cr
Sawtooth Cr
Roaring Lion Cr

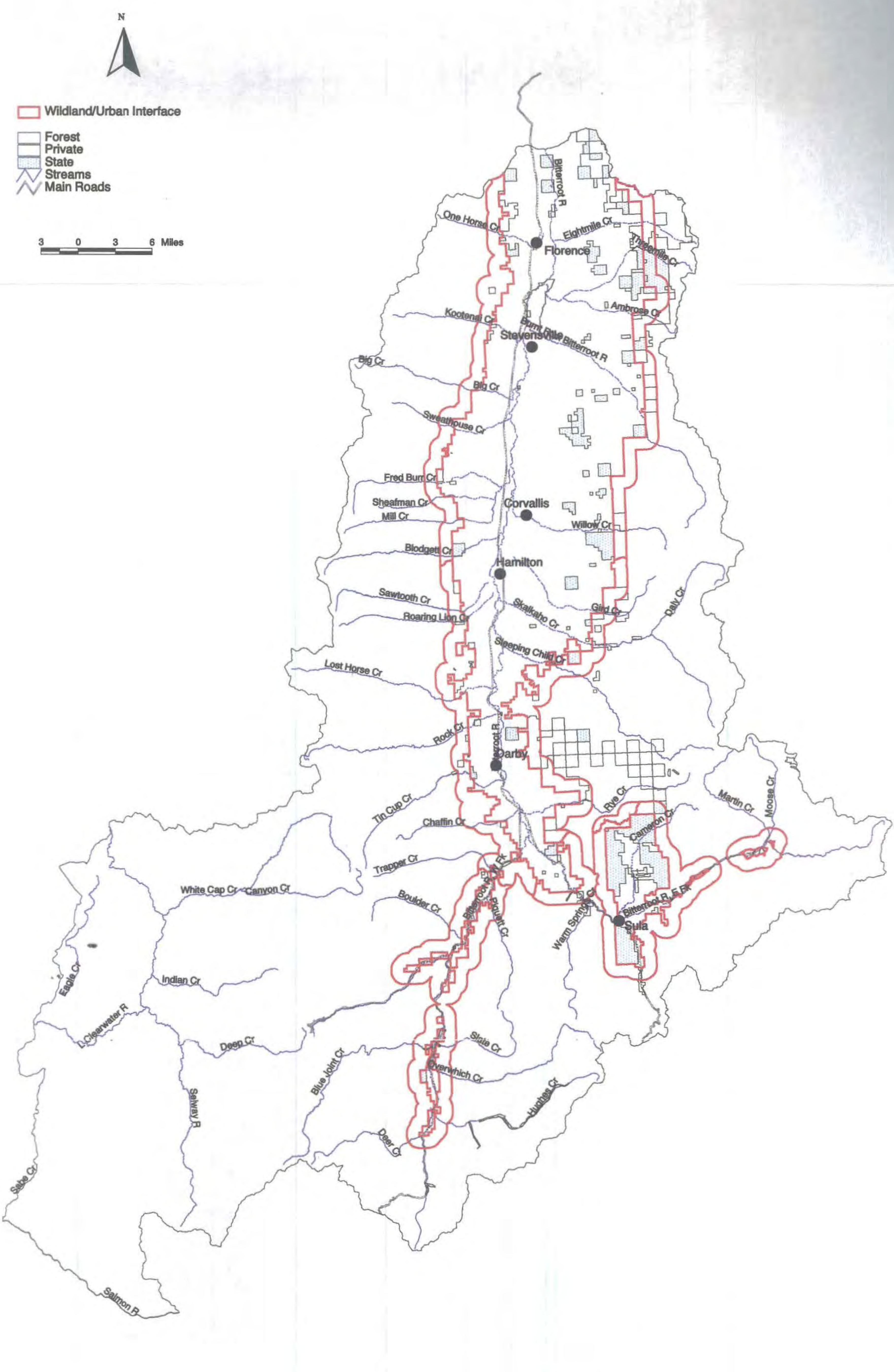
# Map 3: Selway Salmon Fire Severity

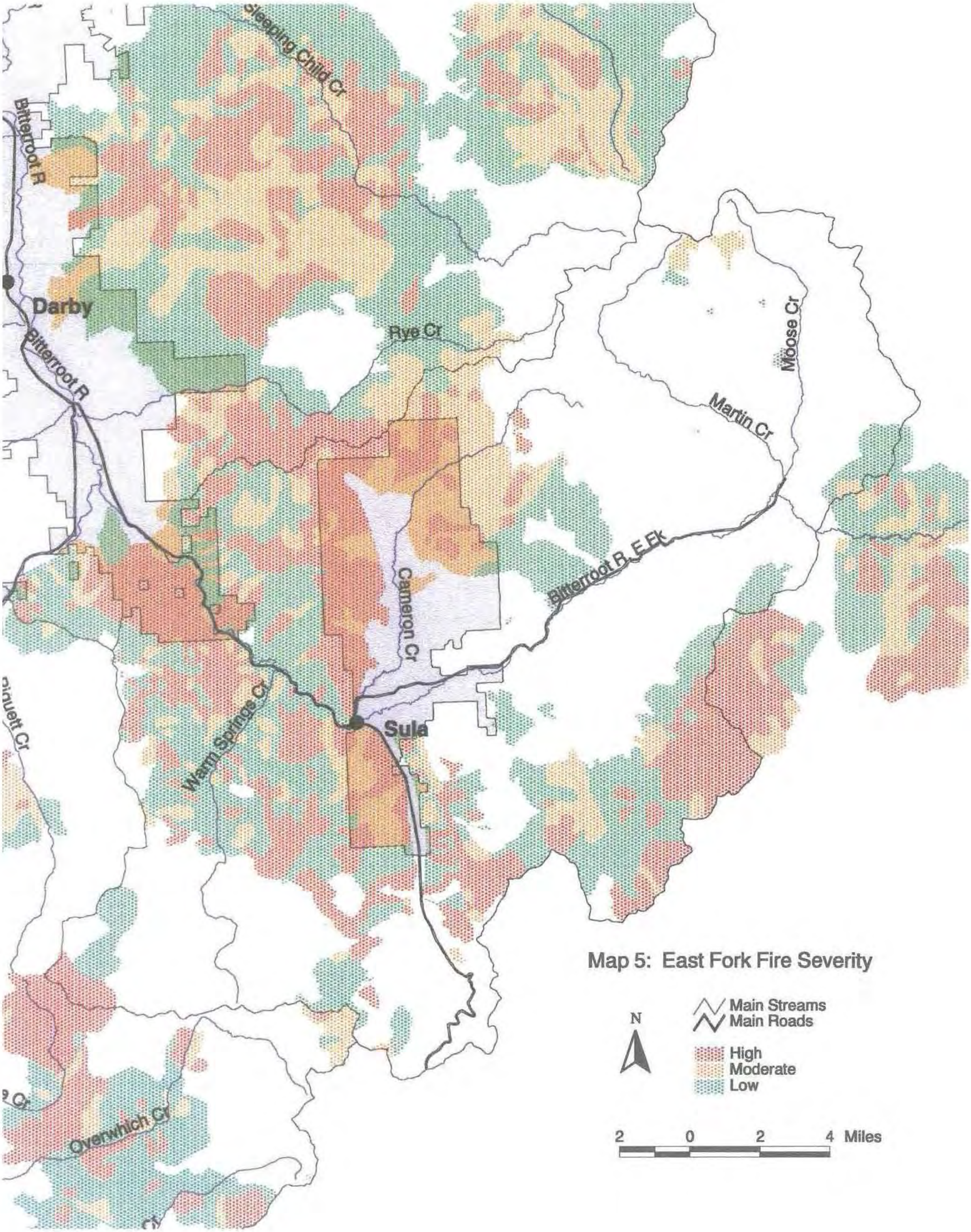





Map 4: West Fork Fire Severity

# Map 7: Wildland Urban Interface Lands




Sleeping Child Cr
Bitterroot R
Darby
Bitterroot R
Rye Cr
Moose Cr
Martin Cr
Cameron Cr
Bitterroot R. E.Fk
Sula
Warm Springs Cr
Overwhich Cr
Map 5: East Fork Fire Severity
N
Main Streams
Main Roads
High
Moderate
Low
2
0
2
4
Miles

# 3.1 Public Comments and Opinions

### 3.1.1 Background and Community Engagement

Following the 2000 fire season, a team was assembled to document the post-fire resource and social conditions on the Bitterroot National Forest. A Community Engagement Program, involving valley residents, was an integral part of this process. During October and November, twelve meetings were held in six different communities in the Bitterroot Valley. The "Community Opportunity Series: Learning Together From Fire Season 2000", meetings were set up in two "rounds".

The goals of the Community Engagement Program were to create an opportunity for residents to give input into the direction and content of the post-fire situation report, and to continue and enhance positive interaction between the Forest Service and local communities.

The first round of meetings provided opportunities for participants, both Forest Service and citizens, to experience each other as people and neighbors who shared a history-making event. The meetings focused on shared values and fostering a spirit of what "could be" rather than "what isn't". Together participants explored what the fires meant to Bitterroot Valley communities. They also identified key questions about the fire and rehabilitation that they felt required answers.

Some key thoughts expressed during the first round of meetings included:

- An understanding that all people in our communities, regardless of their personal backgrounds, shared many of the same fears related to the fire season.
- An understanding and appreciation of our communities' ability to cooperate and work together.
- A desire to continue listening to one another and striving to find common ground.

While first round participants appreciated the opportunity to share their stories and recognized the value of one-on-one interactions, they frequently requested more detailed information about the condition of the resources and the ongoing recovery efforts.

Attendance at the meetings was generally low (about a total of 100 residents attended), but the information collected was very valuable as was the opportunity to build and enhance relationships amongst the participants.

Thoughts, concerns, and priorities generated by community members and agency resource specialists during the meeting series are summarized in the following section.

## 3.1.2 Public Responses

### *3.1.2.1 Information Needs*

**Question: What kind of information do you think we need to assure that we do the best job possible?"**

Answers fell into four categories:

1. **Context of the 2000 fire season**
   - "What happened and what does it mean?"
   - "We need to realize that fire is a natural and essential process." We need to "understand natural processes," and design management strategies for recovery to compliment the natural processes and ranges of variability.
   - Determine how to mitigate the risks of fire to unburned areas.
   - Determine "how national laws and policies will affect management of our local forests."

2. **Community Needs**
   - Collect public's desires and priorities from a "broad cross-section of opinions."
   - Determine ways communities can help in recovery, and work on mobilizing communities.
   - Need to learn how other people and places recovered from similar incidents.

3. **Scientific Data on Fire Effects**
   - We need "results from past monitoring - 'true facts' both long and short term."
   - Information about the "effectiveness of treatments in reducing fires."
   - Effects on water yield both with and without treatments, and both pre-and post-fire.
   - Good data on how many trees are going to live and how many won't, as well as how much volume there is and where it is located. We need to decide, "Are we going to salvage log? If not, why not?"
   - Good burn intensity maps.
   - Determine "where we are going to reseed/replant, and what types of seed we will use."

4. **Planning Needs**
   - "What are the recovery options, and what is the best approach to take from both the Forest Service and public standpoints?"
   - Determine "immediate needs and long-term goals."
   - What will the forest look like in 20-30 years "if we don't deal with standing burned/dead trees?"

#### *3.1.2.2 Top Priorities for Forest Community Recovery*

**Question: What are the top priorities for Forest and community recovery?**

Answers fell into five categories:

1. **Community Needs**
   - Communication – Community engagement.
   - Seek and use "local input" – input from those most affected.
   - Public needs to learn more about Forest Service policies, goals, and objectives.
   - Education for adults and children about fire.
   - Use local labor for rehabilitation work – provide economic opportunities.

2. **Vegetation Management**
   - Reforestation
   - Salvage logging – "don't let dead trees go to waste." Use "good science" to determine what should be done with dead trees.
   - Create "healthy defensible forests" – "reduce catastrophic fire potential" – "eliminate fuel loading."
   - Manage unburned forests (e.g., thin).
   - Use prescribed burning.
   - Wildlife habitat

3. **Wildland/Urban Interface**
   - "Public education regarding home/property protection" – "education for adults and children about fire."
   - "Don't let people forget about taking action to reduce the risk of fire to homes in the interface" - "be responsible for ourselves."

4. **Watershed Needs**
   - Water quality – are mitigation measures working?
   - Protecting land from erosion – controlling run-off – preventing flooding.

5. **Noxious Weeds**
   - Control weeds in burned areas – use herbicides.

#### *3.1.2.3 Forest/Community Working together*

**Question: How would you like to see the Forest Service and the community work together during the recovery efforts and beyond?**

Answers fell into three categories:

1. **Attitudes**
   - "Maintain a sense of community" – an "in it together" attitude.
   - "Acknowledge the complexity" of forest management issues.
   - Treat each other with mutual respect.
   - Eliminate the distinction between public, agency, special interest groups – become ONE.

2. **Communication Methods**
   - One-on-one interactions (informal and personal) are very effective.
   - Field trips and interactive learning.
   - Help people understand resource issues.
   - Make sure people get all their questions answered at public meetings.

3. **Objectives and Outcomes**
   - Be sure people feel comfortable to make their voice heard.
   - "Provide accurate information as soon as possible."
   - Seek input from "people that aren't traditionally involved in forest management issues."
   - Focus on projects that are widely supported and don't "polarize communities."
   - Work together to make homes defensible – work "across boundaries."
   - "Change ability of individuals to stop management decisions with a 33-cent stamp."
   - "Change laws and systems in place that prevent managers from being able to manage."

### Summary of Round 1

- We discovered "common ground/similar experiences."
- We discovered that we shared the same fears and anxieties regardless of our backgrounds – "the Forest Service and the public are not as far apart as we thought."
- "The Forest Service is interested in listening to the community."
- Need to have "local influence in the process" – "people need to be actively involved."
- There's a lot of local knowledge; everyone has something to offer.

## 3.1.3 Information Presented in Round 2

The second meeting series, which was developed in response to suggestions made during the first meeting series, followed an open house format. Resource specialists presented information on resource conditions, risks and opportunities in the wake of the fires, and discussed possible management actions to address risks and opportunities with the public. Much of the information discussed briefly during these meetings are

discussed in much greater detail in this report. The information was presented informally and was geared to respond to the specific thoughts and concerns expressed during the first round. The Forest Service provided updates on the recovery efforts, with particular focus on needs, opportunities, and information requested by Valley citizens. The Forest Service collected additional input in the form of needs, opportunities, suggestions and requests for information. These requests also shaped this report. In general, the suggestions and concerns collected during round two did not differ significantly from that discussed during round one, and summarized above.

### 3.1.4 Continuing Public Participation

Early in 2001 and beyond 2001, the Forest will be proposing projects to address issues identified by resource specialists and community members. There will be further opportunities for public participation during this process.

The University of Montana, Bureau of Business and Economic Research is currently conducting a Public Opinion Poll to gather more information about what management activities people think should be done by the Bitterroot National Forest, and to identify worthwhile ways to involve the community in planning these activities. Results of the Poll are expected in early 2001.

# 4.1 Soil Integrity

## 4.1.1 Background

### *4.1.1.1 Introduction to Fire Effects*

The range of potential fire effects on any particular soil property or process is quite large and is dependent on pre-fire soil conditions, fire intensity and frequency, and post-fire management activities. Soils, similar to other components of the ecosystem, have mechanisms that have adapted over time to wildfire. The diversity in vegetation response after fire, within and between plant communities, is a reflection of the complex interactions within soils as they adjust to a changed condition. The pulse of soil erosion that occurs after fire is short-lived and fades as vegetation recovers. Chronic forms of erosion can be associated with human-caused features and activities, such as roads, that accelerate rates over a longer period of time.

The direct and immediate effects on soils from intense heat can create physical and chemical changes and alter soil biota. These changes can be dramatic but are often short-lived. Others changes last longer. Fire indirectly affects soil-water relations, soil stability, and microclimate. In more severe situations, fire changes succession and site productivity.

The pre-fire condition of soils (both natural and management-related characteristics) influences the degree of effects to soils and watershed processes after fire. Intense heat has more severe effects where layers of organic matter are deep, high amounts of fuels are consumed, and soils are dry. Soil compaction can alter infiltration rates and may accelerate runoff effects when combined with the water repellency fire can cause. Suppressed communities of soil biota, whether from lack of organic debris, or too much organic debris, may have lower recovery rates. Nutrient depression from a lack of fire may also result in missing components that would naturally aid in recovery.

**Direct effects.** Fire can consume the forest floor, from partially decomposed organic matter to coarse woody debris. This substantially alters the flow of nutrients immediately and in the longer term (Covington et al. 1990). In the first year after fire, a flush of nitrogen is available to germinating and re-sprouting plants. In moderate and severely burned areas, no remaining organic debris is available to continue the cycle of nutrients. Some will be contributed through rainfall washing through the canopy, but this does not replace the nutrient budget needed to sustain a pre-fire soil ecosystem. Without a new flow of organic debris, long-term deficit of nutrients will occur.

In high-severity burns, all nitrogen and large amounts of phosphorous can be volatilized. Microorganisms quickly latch onto any remaining nitrogen to survive, meaning less is available for recovering plants and vulnerable microorganisms. In the most severe cases, a complete shift of carbon, potassium and calcium versus nitrogen and phosphorous can occur, causing a complete shift in plants supported by the soils. Grasses and other plants that convert nitrogen from less available forms tend to favor

sites where this conversion occurs (Kraemer et al. 1979; Stark and Sasich 1984). These effects account for the natural succession that occurs on the land following fire.

Typical organic matter content in Bitterroot National Forest soils averages 3 to 5 percent in the top 2 to 6 inches of the soil; duff layers at the surface range from 1 to 3 inches in thickness. In the areas burned at moderate and high severity, the entire duff layer has been consumed. Observations from other fires indicate that severe heating can reduce soil organic matter to less than 1 percent (Covington and Sackett 1990). The duff layer contributes to the development of organic matter content in soils. More organic matter means higher soil fertility.

Soil microorganisms are the lifeline between plants and the mineral soil. They enhance the uptake of nutrients and water in droughty, infertile soils, help protect plants against pathogens, provide tolerance to heavy metals, help improve resistance to drought, contribute to soil structure stability, and keep nutrients from "leaching away".

Fire-induced changes either from direct mortality or from changes in soil environment tend to favor one microorganism to the detriment of another (Hungerford et al. 1991). This is usually temporary unless the extent of extreme alteration is 1) large spatially or 2) at an extreme soil depth where migration from areas of refugia may be very slow. Soil biota is dependent on a dynamic flow of nutrients as well as the physical habitat offered by organic debris.

Fungi are generally the most susceptible to heat and changes in soil conditions. This is usually temporary unless the extent of extreme alteration is 1) large spatially or 2) at an extreme soil depth where migration from areas of refugia may be very slow. Actinomycetes are least susceptible, and bacteria are intermediate (Borchers and Perry 1990, Ahlgren 1974, Harvey et al. 1976, Wells et al. 1979, Rose 1983). Sackett (unpublished data in Covington et al. 1990) has found lethal temperatures to a depth of 6 inches where thick duff layers were almost completely consumed. During a fire, temperatures at the soil surface can range from 100 to 800°C, while microbes can survive temperatures from 50 to 160°C. Mycorrhizal fungi, important to enhancing moisture and nutrient uptake in temperate forests, decrease with burning and changes in microclimate. Depending on severity of change in microclimate and the spatial effect of the fire, mycorrhizae re-establishment may occur rapidly or take years (Borchers and Perry 1990).

Organic matter is destructively distilled into hydrocarbons between 175 °C and 315 °C (DeBano 1976). Hydrocarbons are vaporized at 300 °C, and they move downward and precipitate around soil particles at the interface where soil temperatures are cooler. This waxy coating is water repellent, slowing infiltration. Water repellency may last weeks or more than seven years (Baker 1989, DeBano 1979). Water repellency usually lasts no more than one or two years based on experience on the Bitterroot National Forest (Wildey, personal communication). Overland flow from these areas can trigger rill erosion and mass erosion.

Extreme heating, such as with smoldering fires with long burnout (e.g., tree stumps and large logs), alters soil color, breaks down soil structure, and welds individual soil particles together. At the most extreme point, clays begin to disintegrate. These sites have experienced a long-term alteration from their pre-fire condition. Vegetation recovery is set back to early successional stages.

**Indirect effects.** Indirect effects on soils are related to loss of vegetation and rate of vegetative recovery. With moderate and high severity burns, mortality is high. This loss of vegetation removes shade, which affects soil microclimate. Reduced transpiration rates and loss of canopy interception of precipitation change water relations in the soil, and soil moisture content will stay relatively high for longer into the summer. Plants that emerge early will be favored over later season plants.

Soil temperatures will be higher and will experience greater daily shifts due to changes in air temperature and radiant heat effects. This may effectively change the vegetation on a south-facing slope from forest to meadow, and from forest to shrubland on a low-elevation, rocky, westerly slope.

Removal of vegetation cover in the canopy and on the forest floor lays soils open to raindrop impact erosion and wind erosion. Root mortality decreases soil stability, increasing all forms of surface erosion and shallow rapid landslides. Much of this erosion will effectively redistribute soil surfaces. Some soil may be transported into nearby bodies of water and deposited as sediment.

Long-term effects may change the expected pattern of succession. Ponderosa pine forests may become ceanothus fields or dry meadows. Depression of site productivity may occur in areas "re-burned" after previous prescribed fire or natural fire events. Fire disclimax succession of lodgepole pine may be related to continual nutrient depression from repeated fires consuming organic debris before it has been decomposed and utilized, unlike lodgepole pine stands with a regime of less frequent fires that allows a subalpine fir component to develop in the stand.

### 4.1.2 Issues

The following review of issues and key questions help focus the assessment and the forthcoming recommendations.

- Soils have adapted patterns of recovery to historic fire regimes. Fire suppression has altered fire regimes both in frequency and in intensity. Parts of the Bitterroot National Forest that historically received frequent, light burns were severely burned after a long period of suppression. Other areas potentially received a higher frequency of fire than under historic patterns.

    - *Where will deviation from historic fire regimes have the potential to significantly affect the soils environment and dependent resources?*

- Removal of vegetative cover and duff layers and increased overland flow on thermally altered soils can cause loss of topsoil and increased sedimentation. Erosion is a natural process, and rates temporarily increase post-fire and then decrease as vegetation recovers and duff layers are restored.

    - *What emergency response measures are in place as a result of Burned Area Emergency Rehabilitation (BAER) to protect particularly sensitive areas? Are there additional areas that may respond outside of natural increases in erosion, significantly affecting soil sustainability, vegetative recovery, or other resources?*

- Over 210,000 acres burned outside of wilderness. Post-fire treatments have the potential to cause short-term cumulative effects to soil quality. Removal of wood products, either through commercial harvest or firewood gathering, has a potential to reduce coarse woody debris recruitment and to affect soil physical properties. Conversely, in certain vegetation types, such as low elevation dry Ponderosa Pine/Douglas-fire stands, uncharacteristically heavy fuels could be detrimental to ecosystem processes if they cause soils to be subjected to high temperatures for relatively long duration.

    - *Are current guidelines for soil protection and coarse woody debris recruitment appropriate to provide protection for long-term site productivity?*

## 4.1.3 Historical and Pre-fire Conditions

### *4.1.3.1 Distinguishing Features that Influence Soil Sustainability*

Bitterroot National Forest soils contain layers formed from windblown volcanic ash from volcanic eruptions in the Cascade Range. This unique component is the single most important feature enhancing productivity and watershed function in these soils. Surface layers with this component offer a superior growth medium over soils formed in native parent materials. They have a high water holding capacity and a high level of air space; they act as a sponge, soaking up snowmelt and rain. This regulates runoff, retaining water longer than soils without the ash component. Soils with the greatest expression of volcanic ash are at high elevation on northerly aspects (Andic Cryochrepts). Volcanic ash mixed with other parent materials occur on other aspects and at lower elevations (Dystric Cryochrepts). Complex interactions with soil pH and a unique clay called allophane create a need for continual input of nutrients from the forest floor and assistance from soil biota to retain and convert nutrients for plant growth.

Another very important consideration in recovery after wildfire is that soils in native parent materials have a relatively narrow range of soil fertility. A dry, cool climate, infertile parent materials, and relatively recent landforming processes have created a setting of "youthful" soils reliant on continual nutrients flowing from decomposing organic debris from the forest floor.

One measure of fertility is cation exchange capacity (CEC): Temperate forests in western Montana range in CEC from 3 to 30 meq/100g (Sasich 1985). Two-thirds of the burned area is underlain by granitics and associated gneisses of the Idaho Batholith. They produce soils with CECs ranging from 3-6 (McBride, 2000). Metamorphosed rocks of the precambrian Belt Series underlie the other third. Soil CECs range from 6-15 (Sasich 1985). Volcanic intrusions are known for higher instability along their margins. They produce soils with moderate fertility.

Significant areas of soils in the East Fork of the Bitterroot, Rye Creek drainage, and headwaters of Skalkaho/Sleeping Child are in highly weathered coarse-grained granitic parent materials. Soils formed in this "grussic" parent material are the most infertile soils on the Forest. They have a coarse sand matrix and very low water holding capacity. Vegetation understories tend to be naturally sparse, particularly on southerly aspects. Natural rates of erosion are high in these soils, and the potential for accelerating erosion from management practices is also high. The soils are intermingled with those formed from more fine-grained granitic or associated gneiss bedrock. Soils formed in fine-grained granitic parent material are moderately coarse in texture, having more fine sands and some silt with rock fragments. They have a slightly higher water holding capacity, but fertility is low. Soil stability is slightly higher. Because these two soils are intermingled, it is difficult to predict which one dominates a given part of the landscape. Soils in the West Fork, Wilderness Complex and Blodgett/Mill/Sheafman analysis areas

tend to have less "grussic" soils than in the East Fork, Rye Creek and headwaters of Skalkaho/Sleeping Child.

Soils on metamorphosed Belt series parent materials have moderately coarse textures, higher fertility, and higher water holding capacity. They have a higher rock fragment content and tend to be less subject to erosion. These soils occur in some headwater tributaries of the East Fork, but mostly in the Skalkaho and Sleeping Child watersheds.

As with any generalization, there are exceptions. Within each area, there are soils influenced by glacial or alluvial parent materials and inclusions of dissimilar soil materials. Landtype analysis of the Bitterroot National Forest is a valuable reference for more detailed information on soil features and locations (McBride, in progress).

Three landforms pose a higher potential for slope instability within the burned area: breaklands, convergent stream headlands, and glacial troughs. Slope gradients of breaklands and troughwalls are near natural angle of repose. Naturally sparse vegetation on south-facing slopes in combination with high precipitation events can cause landslides. Convergent headwalls also have high sediment delivery efficiency because of high stream density. The network of poorly defined or developed stream channels (0 and 1st Order) converging to either a 1st or 2nd Order channel create a scenario highly vulnerable to changes in runoff. On the other hand, soils in these landforms tend to have deeper duff layers and volcanic ash-influenced surface layers, which in the forested setting act as moisture reservoirs and buffer runoff response.

### *4.1.3.2 Soils and Fire on the Bitterroot*

Wildfire is one of the major disturbance agents for Bitterroot National Forest ecosystems. Soil processes and functions are a reflection of this and other factors. To understand how the fires of 2000 may have affected soils, it is useful to compare the historic patterns of fire across the landscape and how closely the fires of 2000 emulated those patterns.

Section 4.5 reviews in detail the historic fire regime in relation to plant communities across the landscape and compares recent patterns of fire and fire suppression. Findings are summarized for this discussion.

Changes in fire regime from historic patterns have probably had an effect on some soils. These changed conditions are:

- In the last 100 years, VRU2 (warm, dry ponderosa pine and Douglas-fir habitat types) and VRU3 (cool, dry and cool, moist Douglas-fir habitat types) have experienced suppression of what were frequent, low intensity fires and low severity burns. These sites are the warmest and driest on the forest. A large amount of nutrient base is tied up in the forest floor in these sites with fire suppression **(Figure 1-1, Appendix A)**. Historically, frequent fires released nutrients that were in turn rapidly utilized by plants. Stands were generally

thinned by fire but not consumed, which led to a continual flow of organic debris to the forest floor. Stands were more open, which regulated competition for limited water and nutrients on inherently infertile soil types **(Figure 1-2, Appendix A)**.

- Fire frequency and intensity are relatively unchanged from historic regimes in VRU4 (cool lodgepole pine and lower subalpine habitat types) and VRU5 (cold, moist, upper subalpine and timberline habitat types). Decomposition rates for organic debris are slower on these sites; this provides a gradual release of nutrients between fire periods. Supply of nutrients may have never met demand, except immediately after a fire. Lodgepole pine favors this VRU. This species is highly tolerant of harsh site conditions such as infertility and wide swings in microclimate and moisture regime. These plant communities are most likely reflective of wide swings in the soil environment as well.

## 4.1.4 Effects and Implications of the Fires of 2000

### *4.1.4.1 Potential for Soil Heating*

Summary reports prepared by BAER soils teams after the fires of 2000 suggest that burn severity varied widely across burned slopes. Burn severity mapping is a generalized view of the overall conditions. Variability exists within each polygon. Ratings are based on the following standards (BAER Handbook, FSH 2509.13):

- High severity – More than 40% of the polygon exhibits soil features likely to significantly increase runoff and erosion, e.g., absence of duff layer, hydrophobic soils, soil discoloration.
- Moderate severity – Less than 40% of the polygon exhibits high severity indicators. Duff layers may be absent or mostly absent.
- Low severity – Duff layers are burned but intact. Unburned areas are intermingled with lightly burned areas.

Although it is likely that all types of fire behavior occurred, surface fires with deep flame fronts were the norm. Considerable soil heating is possible with this type of fire. Where crown fires occurred, soil heating was likely less. North facing basins and flat stream bottoms and benches tend to have thicker accumulations of duff. Ponderosa pine forests under fire suppression management also accumulate thick layers of needles and duff. A combination of surface fire, topography that holds heat longer, and accumulations of organic matter on the forest floor is a formula for more severe effects to soils. Locations of water repellent soils tell us where soil temperatures were severe. Using burn severity mapping and the rating standard of 40% alteration of soil properties, it is estimated that 27 % of the burn area may have severe soil effects.

Variability of burn severity dilutes effects on soils. Lightly burned areas act as refugia (reservoirs of remnant organic debris) and catchment areas for eroding soils. We have observed some of these aboveground processes already occurring. Another important process is needle fall. Shortly following a fire, scorched needles fall to the ground and begin to restore soil biota habitat as well as protecting the forest floor from erosion and high evaporation rates.

### *4.1.4.2 Soil Biota*

Biota mortality probably occurred where fires burned at moderate and high severity, with variations in depth and extent. It may take a year to a few years and, in extreme cases, many years, for soil biota to return from refugia. Nutrient input and overall soil condition will greatly affect rates of recovery.

In the more extreme cases, competition between soil biota may be evident as different rates of vegetation recovery, or even a successional shift, occur. Recovery of biota populations may be delayed in homogeneously burned areas and in large areas of re-burn where the resident population has been exhausted. This may have profound effects on soil conditions and productivity.

Areas where soil biota were depleted or stressed before the fires, i.e. from fire absence in VRUs 2 and 3 (see Section 4.5.3 of this document), re-burn, or soil compaction, are vulnerable to altered recovery rates. For example, areas burned in 1910 and then re-burned in 1919 reflect a lower productivity than adjacent stands that were not re-burned (Kamps, 2000). Another example is from a study conducted on the Lolo National Forest. This study found that anaerobic microbial activity was much higher than aerobic activity in compacted soils, supporting an outbreak of root disease (Stark and Sasich, 1984). More anaerobic than aerobic microbial activity in well-drained temperate forest soils is abnormal.

Mechanized activity may damage soils during periods of high soil moisture. Duration of these "inoperable" periods will be longer for the next 2 to 5 years in moderate and high severity burn areas. These areas have no protective duff layer and are at increased risk of rutting and displacement. This will increase the challenge of conducting operations without impairing soils.

### *4.1.4.3 Nutrient Cycling*

The fires consumed huge amounts of fine and coarse woody debris. The nutrient recruitment base is now held in the standing trees, dead or alive, and in the recovering understory. All areas should experience a short flush of nutrients that will favor germination and re-sprouting. Moderately and severely burned areas will rely on recruitment of all size classes of woody debris over the long term. Historically, the amount of woody recruitment to the forest floor following fire, varies by elevation and vegetation type. Cooler, higher elevation sites were historically adapted to larger pulses of woody recruitment, than warmer, dry sites such as VRU 2. In all vegetation types, deposition of woody debris well below post-fire historic conditions could reduce the nutrient budget of the inherently infertile granitic soils.

As a site recovers its nutrient budget, unregulated firewood gathering and salvage harvest present both benefits and risks to natural recruitment of fine and coarse woody debris. Woody debris left on the ground after these activities would be beneficial as long as debris levels are within the ranges of historic variability. In VRU 2, too much debris on the ground has the potential to contribute to hotter than normal future fires. If too much woody debris is removed from a site, and not enough is left on the ground, then the activities would be detrimental to the soils nutrient budget. Course woody debris guidelines for VRU's are provided in section 4.5.7 of this document.

Prescriptions that favor introduction of frequent, low-intensity fire in VRU2 would increase nutrient input to a more natural level. Maintenance of coarse woody debris recruitment as a desired future condition will be essential to help sustain long-term contributions of nutrients.

#### *4.1.4.4 Topsoil Loss*

BAER models estimate that potential erosion could range from 3 to 6 tons/acre (Table 1-1). This equates to loss of from .006 to 1/16 inch of topsoil if averaged over the entire analysis area. Of course, erosion occurs in a more concentrated fashion and effects would be felt more profoundly in some areas than in others. These models were summarized by watershed and used to project sediment yields. In order to fully understand the potential topsoil loss, one would need to recalculate erosion by year for similar landtypes and then compare to a natural baseline for those landtypes.

BAER and the Bitterroot Interagency Recovery Team surveyed areas at high risk of soil loss and applied erosion control treatments.

***Table 1-1. Erosion potential calculated for a 10 year-24 hour storm event from BAER reports***

| Fire Name | Erosion Potential ($yds^3/mi^2$) | Erosion Potential (tons/acre) |
|---|---|---|
| Blodgett | 2105.6 | 3.90 |
| Rye/Burke | 2861.0 | 5.30 |
| Skalkaho | 2618.5 | 4.85 |
| Valley Far East | 3503.3 | 6.49 |
| Valley Phase 1 | 3180.0 | 5.89 |

It is reasonable to assume that the most severe potential for soil erosion has already been mitigated by BAER efforts during the fall, 2000. This is not to say there will be no areas of obvious soil erosion, but they should be concentrated and well within natural conditions after a fire. Areas of surface erosion have already been observed **(Figure 1-3, Appendix A)**. They are localized and associated with water repellent soils, runoff from impenetrable surfaces (i.e., roads and bedrock outcrops), and slope gradients and road fills that exceed the stable angle of repose. Soils formed from granitic parent materials have a higher incidence of erosion than soils formed in other soil parent materials. There is good evidence that intact duff layers, irregularities in burned and unburned areas, and needle fall where burn severity was light to moderate will adequately protect sites from excessive, widespread erosion.

Some areas have a higher risk of erosion that surpasses a management standard (for example, natural rates of erosion are exceeded, loss of productivity becomes unacceptable, or visual quality may be adversely effected). These areas are targeted for monitoring. They are:

- Homogenous high burn severity on slopes exceeding 50 percent on soils formed in highly weathered granitics.
- Homogenous high burn severity on stream breakland landforms.
- Homogenous high burn severity on slopes exceeding 60 percent on soils formed in hard granitics.
- Homogenous high burn severity on slopes exceeding 65 percent on soils formed in metamorphic Belt Series parent materials.
- Accelerated erosion caused by runoff from roads or trails.

Specific areas at high risk of significant soil loss were noted by BAER specialists during field surveys and were further identified using GIS review of steep slopes associated with high severity burn. Only areas within the Forest boundary are listed here.

**Skalkaho/Sleeping Child/Rye:**
Benson Creek headwaters
Newton Gulch
North Fork Rye Creek breaklands
Rye Creek breaklands downstream from confluence with N. Fork Rye
Skalkaho Creek drainage – local erosion on north-facing stream breaks
Sleeping Child Creek breaklands between Two Bear and Divide Creeks
Sleeping Child Hot Springs – slopes above springs

**West Fork:**
Chicken Creek steep slopes
Little Blue Joint Creek steep slopes
Overwhich Creek breaklands
Slate Creek (upper) steep slopes
Taylor Creek (upper)
West Creek steep slopes (small area)

**East Fork:**
Cameron Creek breaklands
Hart Creek breaklands
Laird Creek (lower and mid) breaklands
Maynard Creek steeper slopes
Medicine Tree Creek steeper slopes
Reimel Creek breaklands
Tolan Creek (upper) steeper slopes

**Wilderness Complex:**
Chuckling Creek steep slopes
Three Lakes Creek (upper) steep slopes

**Blodgett/Mill/Sheafman:**
Churn Creek steep slopes
Cow Creek steep slopes
Tag Alder Creek steep slopes
Tamarack Creek steep slopes

Topography, soil type, and burn intensity conditions vary within the above areas and therefore post-fire soil conditions are not entirely consistent.

## 4.1.5 Objectives and Recommendations

### *4.1.5.1 Response to Threat of Continued Soil Loss*

BAER treatments have addressed the greatest threats to property and life. Wholesale aerial seeding of areas with high potential for erosion was not performed; observations have demonstrated that seeding is not necessarily the best or most economical way to prevent soil erosion after a fire. On the Bitterroot, needles killed by the fires have already begun to fall and trap eroding soils.

A 3-pronged strategy is recommended:

- Complete remaining soil protection work identified by the BAER team.
- Evaluate BAER work to identify locations where long-term protection is needed, e.g. shrub planting, live wattles and other bioengineering treatments.
- "Wait and see" and treat soil erosion areas on a case-by-case basis.

**Natural range of variability.** Severe burns in VRUs 2 and 3 should receive particular attention. These burns were, for the most part, outside the natural historic regime; high erosion rates after fire would also be outside of natural response.

Decisions to control erosion should be made based upon increases over a natural rate and total loss evaluated over the long term. Many erosion events will be short-lived and localized, creating diversity in the landscape. Inventories in the next year will identify erosion that has the potential for long-lasting and profound effects.

### *4.1.5.2 Coarse Woody Debris Recruitment*

Guidelines for coarse woody debris (CWD) recruitment should meet short-term and long-term needs for nutrient cycling. CWD guidelines were developed by an interdisciplinary team of resource specialists to achieve recommendations that balance near term "on the ground" soil needs, long-term soil needs, desired structural components, wildlife habitat, and historic fuel loading. The resource specialists include: wildlife biologist, silviculturist, soil scientist, and fuels specialist. Literature used to develop these guidelines included Graham et al., 1994; Fischer and Bradley, 1987; and Evans and Martens, 1995. The CWD guidelines are listed in Section 4.5.7.1 of this assessment. When in doubt, the CWD guidelines should err on the side of caution and prescribe more CWD rather than less. Where fuels management is a concern (as in the wild land urban interface), areas where fuels are cleaned up, may be offset by selective locations with heavier fuel concentrations. This may alleviate the cumulative effect of large-scale areas with a scarcity of CWD (Evans and Martens, 1995).

### *4.1.2.3 Avoiding Irreversible Effects on Soil Physical Properties*

Post-fire soil/water relations should be considered when evaluating feasible operating windows for ground disturbing activities. Soils will not dry within normal seasonal expectations without vegetation transpiration. The absence of the protective duff layer and normal slash from logging will present a high potential for negative effects. To avoid soil impacts, operating restrictions should be based on soil moisture rather than season; other options, depending on site, include requirement of 18" of packed snow or aerial/skyline yarding.

Residual compaction may exist in previously logged areas. In order to address potential cumulative effects, these areas will need evaluation to determine whether the potential for compaction exists. Where residual compaction does occur, site-specific prescriptions for logging systems and soil recovery may be needed (FSM 2554.03 and 2403.5, and Forest Plan).

### *4.1.5.4 Management Needs and Opportunities*

✓ Complete BAER work to reduce soil loss:

East Fork Analysis Area:
- 10 Log terraces above red house in Camp Creek (Sec. 3 T1S R22E)
- Log terraces north of Lord Draw (Sec 2 T1N R20W)

West Fork Analysis Area:
- Log terraces/wattles/shrub or tree planting on steep slopes in Little Bluejoint Creek

Area-wide
- Evaluate where shrub or tree plantings will restore long term stability (steep draws, toeslopes)

✓ To prevent soil erosion and provide nutrient cycling, follow CWD guidelines. (See Section 4.5.7.1)

✓ Restore frequent low-intensity fires into VRU 2 through prescribed fire and wildland fire for resource benefits.

✓ Place a high priority on completion of the Land Systems Inventory and transfer of this information to end-users. This is a tremendous stratification tool for monitoring wildfire effects and for providing management considerations. (BAER/BIRT participants indicated that this tool would have been very useful in

gaining a more thorough perspective of potential soil hazards. It would also have provided a seamless analysis tool across ownership boundaries.)

### 4.1.5.5 *Monitoring and Inventory Needs and Opportunities*

- ✓ Conduct inventories in 2001 and 2002 to locate areas of active hillslope or road erosion that pose a significant threat of loss of soil and long-term site productivity. Priorities for restoration work would be based on 1) evaluation of the degree to which erosion rates are outside the natural background rates over time, 2) visual impact, and 3) effects on site productivity or other resources.

- ✓ Monitor implementation of BAER erosion control treatments to assure all recommended projects have been carried out as prescribed. If projects were not implemented, assure that this action was based on appropriate evaluation.

- ✓ Conduct effectiveness monitoring of BAER erosion control treatments to evaluate whether the prescription met the circumstance and the treatment is effective in controlling erosion.

- ✓ Conduct an administrative study to evaluate applications of mycorrhizae to aid recovery; base the study on burn severity in VRU 2.

### 4.1.5.6 *Opportunities to Work with Citizens, Agencies, and Research*

- ✓ Collaborate with research to conduct controlled experiments using re-inoculation of mycorrhizae and other soil biota, combinations of fertilizer/weed control applications, and to validate the role of fine and coarse organic debris applications in supplementing or accelerating the recovery process.

- ✓ To evaluate effects on site productivity, conduct destructive sampling research in mature stands where residual compaction is known to exist. Growth ring and root morphology analysis would be invaluable in evaluating long-lasting effects from soil compaction.

- ✓ Lack of native seeds and seed stock and concerns for introducing exotics limited the amount of vegetative soil stabilization work during BAER efforts this fall. Collaborate with research to determine what levels of soil loss occurred on non-seeded high severity burns compared to sites where seeding occurred. Where non-native vegetation was established, determine the effects on native plant composition.

- ✓ Conduct controlled studies on the effects of salvage logging on soils to increase the information available.

✓ Conduct soil/vegetation recovery studies with local schools and volunteers.

### 4.1.6 Regulations and Direction

The Bitterroot National Forest Plan (1987) was developed as the foundation for management decisions. Forest Service policies found in Forest Service Manuals (FSM) are a reflection of regulations and laws and are in consort with the Forest Plan. As time passes, our understandings change, social values influence implementation of laws and, hence, further guidance refines this foundation. The Forest is scheduled to update its Plan in the near future to be current with these changes. Although the cumulative effects of response to major wildfires are not addressed in the Plan or FSM, they provide a broad framework of considerations within a general forest management context. Size of analysis area for project planning for recovery activities is an important factor in addressing cumulative effects not addressed in the Plan.

The Forest Plan's goal for soil management is to maintain soil productivity. Current guidance for maintaining soil productivity is provided in Forest Service Manuals FSM 2400 and 2500.

- FSM 2554.03 "Design and implement management practices that maintain or improve soil quality. Protection of the soil resource should be emphasized... Design new activities that do not create detrimental soil conditions on more than 15 percent of an activity area. When operations are planned in areas that do not meet soil quality standards due to prior activities, new activities should be planned to meet current standards. Detrimental conditions remaining from prior activities should be ameliorated as part of the current activities where feasible, with the net result being an activity area that is moving toward a net improvement in soil quality."

  Soil quality is defined using the following parameters: detrimental compaction, rutting, or displacement; organic matter reserves; severely burned soil; surface erosion; and mass movement caused by management activities. Physical and biological changes to soil resulting form high-intensity burns of long duration are detrimental. This standard is used when evaluating prescribed fire.

- FSM 2403.5 "...Administer timber program activities to meet the resource management objectives expressed in the Forest Plan...Use....timber management activities to enhance timber and other forest resource values and benefits over time. ...Recognize that timber management may also adversely affect these resources and carry out the activities in a manner that minimizes adverse effects."

- A standard and guideline threaded throughout the Forest Plan is: Utilize soil technical support for land disturbing projects....to meet soil quality guidelines.

There are many laws and regulations that the Forest Plan and manual direction reflect. One of the laws relevant to Burned Area Emergency Rehabilitation is Section 403 of Title IV of the Agricultural Credit Act of 1978 (16 U.S.C. 2201-2205) and Title 7, Code of Federal Regulations, Part 624 (7 CFR 624), the Emergency Watershed Protection Program. This law provides funding assistance to relieve imminent hazards to life and property from floods and other natural disasters that will cause a sudden impairment of a watershed.

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# Appendix A. Photos

**Figure 1-1**. Ponderosa pine/dry Douglas-fir plant community. Fire severity was moderate to high. Frequency has been altered for about 100 years. Soil displacement is low to moderate.

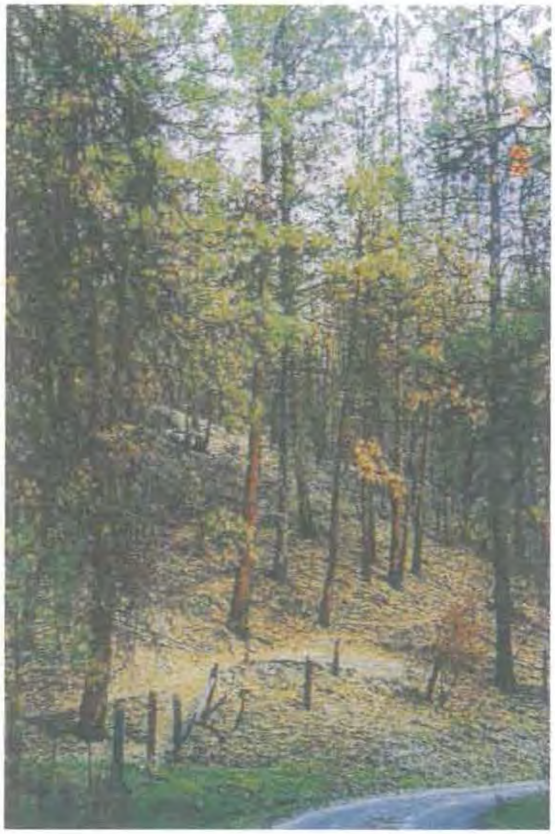

**Figure 1-2.** Historic fire in VRU2 (ponderosa pine/dry Douglas-fir plant community). Fires were of low severity and as frequent as every 10 years. Soil loss was low and nutrient cycling high.

**Figure 1-3.** Surface erosion triggered by runoff from bedrock outcrop on steep, granitic soils.

# 4.2 Watershed Integrity

## 4.2.1 Introduction

### *4.2.1.1 Fire Effects on Watershed Function*

The most influential natural disturbance agents in intermountain west watersheds are wildfire and major precipitation events. Effects on watersheds can be dramatic, particularly when major storm events occur shortly after a wildfire.

Wildfire removes large amounts of forest canopy, increasing local stream temperatures, runoff response to precipitation, and erosion. Increased runoff may erode less resistant streambanks, scour channels, create new channels while abandoning others, and cause floodwaters to occupy floodplains rarely flooded. Increases in flow and sedimentation may cause some streams to extend their range in the floodplain by moving laterally. Large amounts of new woody debris and sediment may be deposited in the stream channel, altering channel morphology. As the stream works through and redistributes this material, new aquatic habitat is created and old habitat is rejuvenated. These effects can *appear* to have a large effect initially to the stream and do present a threat to development within or adjacent to streams.

Wildfires rarely burn homogenously across an entire watershed. Small tributary watersheds may burn severely and have a high response while tributaries burned lightly or not at all will have no change. Effects from the severely burned subwatershed may be diluted as the water flows further downstream. Conversely, if many tributary watersheds are burned severely, effects will be amplified.

The pre-fire condition of a watershed has a great influence on delivery rates of both sediment and runoff. High road densities can increase sediment delivery rate and amount, young stands not "hydrologically mature" can increase runoff rates and add to accelerated runoff from adjacent burned areas, high peak flows erode stream banks, and reduced riparian shade adds to the miles of shade reduced by the fire.

**Overland flow/runoff.** Overland flow occurs when rainfall or snowmelt exceeds soil infiltration capacity. Variables that influence infiltration rates in a forest include all soil/water relations: plant interception and evaporation, intensity and duration of precipitation, gradient of slope, and whether the soil is frozen (Wisler and Brater, 1959). Overland flow rarely occurs in a mature, unburned forest. Interception by the forest canopy, evapotranspiration of vegetation, forest floor litter and decomposing organic matter, and native soil aeration all reduce the potential for overland flow.

Many of the factors that limit overland flow in a green forest change after fire of moderate to high severity. Soils remain saturated longer due to reduced canopy interception and reduced evapotranspiration. Where soil heat intensity is high, soils can become water repellent from restructured hydrocarbons forming around soil particles. Microclimates change; soils have wider swings in daily temperatures and may experience diurnal freeze/thaw where they had not before.

Slope gradient increases the effects and the rate of overland flow, which eventually becomes runoff and is delivered to streams. The amount of erosive energy determines the amount of potential sediment delivered to a watercourse. Summer storms are a much more efficient eroding force than overland flow from snowmelt (Hewlett and Nutter 1969).

**Stream flows and channel response.** For a wide range of burn severities, the impacts on hydrology and sediment can be minimal in the absence of precipitation (Robichaud, 2000). Watersheds where less than 25 percent of the area has high or moderate burn severity may result in less than a 10 to 15 percent increase in stream flow with average precipitation events (Farnes, 2000b). However, when a precipitation event follows a large, moderate to high burn severity fire, impacts can be far-reaching (Rinne, 1996 in Robichaud, 2000).

Combined with high variability in distribution of fire effects, no two watersheds exhibit the same response to changes in watershed conditions. Differences in watershed size, geology, landforms, and management/disturbance history all play a role in adding complexity. However, there are similarities within stream systems that have similar routing and flow characteristics.

Channels either tend to transport sediment and water very efficiently in a short period of time or accumulate and route sediment, responding more slowly. The nature of these two processes, transport and response, vary by substrate type. Naturally, substrate is a reflection of the geology and inherent erosion rates. In managed watersheds, substrates can be altered by the change in size and amount of sediment and the rate of flow energy to route that sediment. A bit oversimplified, but useful all the same, transport-and-response stream reaches become a benchmark for observing response to disturbance and recovery. Changes in channel morphology can be a reflection of changes in flows or increased sediment (or both) or a response to a structural change in the channel or streambank.

**Water quality.** Changes in physical or chemical quality of streams are usually temporary or transitory and dependent on flow regime.

Ammonium-N and phosphorous concentrations can increase an order of magnitude after wildfire and organic-N can double (Hoffman and Ferreira, 1976). These concentrations are temporary and are usually brought in by pulses of delivered sediment from hillslope erosion. Most intermountain forest watersheds are relatively nutrient-poor. Indications are that these nutrients are rapidly taken up by microbiota in the streams, enriching the food base for recovering aquatic life.

Nutrient-rich sediments carried downstream in suspension can deposit in reservoirs and slower moving irrigation canals, causing eutrophication or reducing storage area. They

also are retained for later release in floodplains and wetlands; this is one of the natural processes of nutrient cycling for streams.

Turbidity can greatly increase during snowmelt and rain runoff from hillslope erosion and bank erosion after fire or a severe storm event. Suspended fine sediment and ash detritus can be carried long distances during high streamflow and may not settle out until streamflow diminishes or slows, as in a backwater or eddy. Fine and coarse sediment remobilize when stream flow energy increases. These "channel maintenance flows" are very important.

### *4.2.1.2 Fire 2000 Overview*

The wildfires of 2000 swept over about 293,000 acres of the Bitterroot River drainage and about 63,500 acres in the wilderness lands of the Selway River and Salmon River drainages on the Bitterroot National Forest. Fire burned with low to high severity over watersheds in the East and West Fork of the Bitterroot. Fewer watershed acres were burned severely in the West Fork; Chicken Creek, Little Blue Joint, and upper Slate Creek received the highest extent and severity. Several extensive areas in the East Fork were severely burned; these include Cameron, Meadow, Upper East Fork, Medicine Tree/Maynard/Laird, Tolan, and a few other watersheds. Wildfires in the Selway and Salmon River drainages covered 12 subwatersheds. Burn severity was well distributed and overall severity was low. Sleeping Child and Rye Creeks also received extensive areas of high severity fire. Canyon/Blodgett/Mill/Sheafman had a mix of burn severity with very small acreages of high severity within the major canyons. Small tributaries originating on the Bitterroot face received moderate to high severity burn.

The fire burned 20,581 acres of highly sensitive landforms, including small inner gorges, breaklands, and stream headlands. These areas have a high potential for sediment-delivering mass movement or surface erosion runoff events. Roads and poorly designed salvage activities could accelerate erosion beyond natural background levels.

### *4.2.1.3 Distinguishing Natural Features*

The following paragraphs discuss distinguishing natural features that may influence watershed response and recovery.

**Bitterroot River mainstem.** The main stem of the Bitterroot River flows through a broad, low-gradient valley while working through deep deposits of alluvium. Large bars of gravel and cobbles are distributed throughout. As the valley widens at about the confluence with Sleeping Child Creek, the river becomes braided with many channels. Bank erosion and channel migration are the norm, usually responding significantly to 50-to-100 year storm events. Short segments are confined to a single channel, either by U.S. Highway 93 and secondary roads or the railroad near Hamilton and Stevensville. Secondary roads, streamside residences, and other land uses have affected connection

with its floodplain or armored banks from migration in many locations. Associated floodplain vegetation is altered, although most stream-margin vegetation is intact.

The Bitterroot River appears to be aggrading – adjusting to large amounts of material left in the valley from glacial times. Its channel morphology tells us it is a "response reach" where channel migration, bank erosion, and flooding are natural responses to significant storm events and increases in sediment.

The East and West Forks contribute more than a third of the flow to the main stem of the Bitterroot River.

**Canyon/Blodgett/Mill/Sheafman.** These are high-gradient streams that originate high in the Bitterroot Mountains and flow east through steep, glaciated, U-shaped valleys formed in granitic rock and associated gneiss. Steep slopes with shallow soils are common. Low capacity for water storage causes runoff to be rapidly delivered from snowmelt and rainstorms. Small basins in the headwaters make particularly important contributions to year-round flows and temperature regulation by storing and slowly releasing meltwaters from the winter's snow. These channels are mostly transport reaches until they reach the upper terraces of the Bitterroot River valley floor.

Several small tributary streams originate along the mountain face, rapidly descending through steep V-notch inner gorges (e.g., Cow and Tag Alder Creeks). Streams are "flashy", responding rapidly to precipitation. Channels are "underfit" and very sensitive to scour from increased peak flows. Inner gorges are sensitive to streams undercutting along hillslope margins; this can increase hillslope erosion or debris slides.

**Rye/Sleeping Child/Skalkaho.** Skalkaho and Sleeping Child Creeks originate in the broadly sloping headwaters of the Sapphire Range. They flow west through a variety of bedrock types and landforms, creating a high degree of diversity in channel substrate, bank stability, runoff regimes, channel morphology, and fine sediment regimes.

Rye Creek flows through granitic bedrock, much of which is coarse-grained, highly weathered, "decomposed" granites. Substrates are sandy with round gravels that create a high degree of natural scour as they move through the channel. Large woody debris, roots of trees, and shrubs along the streambanks retain bank stability. Streams dominated by decomposed granites tend to be less productive.

**East Fork.** The East Fork of the Bitterroot River originates high in glaciated basins of the Sapphire Range. Some basins are underlain with metasedimentary rocks of the Belt Series and others with granitic bedrock. Many tributary streams flow through moderate- to low-relief landforms dominated by decomposed granitic parent material and then into broad, low-gradient meadows prior to reaching the East Fork. Cameron and Meadow Creeks are examples. Glacial and alluvial deposits of mixed origins and sandy materials from granitic bedrock influence substrates of the East Fork. The East Fork flows through low gradient montane valleys and in confined narrow valleys,

intermittently transporting sediment efficiently and then behaving as a response reach in other segments. Midway, the East Fork makes a bend and flows north to meet the West Fork. In this reach, the valley narrows and smaller tributaries flowing through moderate- to high-relief landforms efficiently route runoff and sediments from weathered granites to the main stem.

Roads are a major impact in disconnecting the East Fork and Camp Creek from their floodplains and restricting channel migration. Natural detritus from meadows and woody debris are important to boosting nutrient capital in these streams.

**West Fork.** Painted Rocks Reservoir regulates flow and sediment routing in the lower half of the West Fork of the Bitterroot. Below the dam, the West Fork is sediment-limited and, at times, flow-limited. Channel morphology, substrates, and gradient of tributary streams above Painted Rocks Reservoir are influenced by numerous faults, volcanic intrusions within metamorphic bedrock, and weathered granites. Landforms are very diverse, ranging from low relief to very steep breaklands. Below the dam, the Nez Perce Fork is a major contributor of stream flow and sediment to the West Fork. The majority of watershed area delivered from the Nez Perce Fork is from landform and geology similar to the Blodgett/Sheafman area. The Nez Perce Fork drainage did not have large fires in 2000.

**Wilderness Complex – Selway/Salmon.** The two major areas where fire concentrated in the Wilderness Complex are distinctly different in their physical characteristics. The areas burned in the Selway are in headwater tributaries flowing through glaciated landforms developed in granitics and associated gneiss of the Idaho Batholith. Streams route and store sediment through a diversity of channel types; most are of high or moderate gradient. Tributary streams move sediment and runoff rapidly during snowmelt and summer storms.

Landforms burned along the Bitterroot National Forest portion of the Salmon River, are high-relief fluvial breaklands and steep mountain slopes. Streams rapidly transport runoff and sediment directly to the Salmon River.

## 4.2.2 Issues

The following review of issues and key questions helps focus the assessment and the forthcoming recommendations.

- High-severity wildfire can result in significant increases in stream flow, sediment and wood. The degree of effect is dependent on precipitation events. Channels respond to increased inputs by eroding their banks, overtopping their banks, and moving laterally. These changes can affect in-stream and adjacent structures, irrigation systems, and municipal watersheds.

  - *How and where will changes in erosion, streamflow and/or sediment routing influence channel migration, flooding, or bank erosion that may affect downstream or adjacent resources?*

  - *What emergency response measures are in place as a result of BAER and BIRT? Are there additional areas where we may effectively reduce sediment sources or delivery?*

  - *Within the ecosystem context, will channel processes respond within their natural range of variability after wildfire?*

- Fire-related mass wasting has occurred in the past on the Forest. We know that concentrated runoff from water repellent or saturated soils to undersized channels and loss of root strength are triggering mechanisms when combined with a high intensity storm or high snowmelt rates. Although landslides may be uncommon and localized, their potential for impact to stream recovery, roads or other facilities is high.

  - *What areas are susceptible to landslides that have potential for delivery to streams or impacts to property?*

## 4.2.3 Historic and Pre-fire Conditions

Watershed processes are greatly influenced by their geologic history. Glaciations and subsequent fluvial erosion through different bedrocks and fault lines have created the stream patterns, the amount of bedload, and inherent runoff response that we see today. Routing of water, sediment, and woody debris is a function of stream gradient and flow. Most streams in their upper reaches transport inputs efficiently downstream to lower gradient reaches, which respond to the inputs by deposition, flooding, and channel migration. Extensive areas of shrub fen (wetlands) and beaver dams existed along the East Fork and several tributaries. Major shrub fens most likely existed along the mid and lower reaches of Camp Creek, Meadow Creek, and Cameron Creek as well. Meadow Creek's shrub fens are largely intact. Wetlands provide great diversity and richness in habitat and foraging for aquatic and other species. They buffer response from disturbance by, storing nutrients and sediment transported from upstream, and slowly releasing them downstream.

Retention of nutrients in mountain streams with small floodplains and no wetlands was always low and stream ecosystems were limited in nutrients. Aquatic life was dependent on woody debris and other detritus moving through the system during spring flows and flooding of floodplains to cycle nutrients after fire events. Most streams have not changed, although some lowland reaches where grazing occurs in riparian areas have higher inputs of nutrients than they received in the natural condition.

Stream temperatures were cool and regulated by ground water temperatures. Temperatures varied little. Today, some segments have higher temperatures because of loss of shade from shrubs or trees. Most of these are downstream of the National Forest boundary; this increases the importance of shade retention upstream.

Mass wasting events were more frequent as the climate shifted out of the glacial period. We see remnants of this activity in almost every drainage on the Forest. Remnant deep-seated or translational landslides are scattered across the Forest. Shallow rapid landslides have shaped steep, small, inner gorge channels with alluvial or "co-alluvial" fans at their base. Often, fluvial processes continued to contour channels either intermittently or ephemerally, working back and forth across the fans. Other channels have filled in with colluvium from sideslopes and rarely experience surface flow. Many of these channels have broad, moderate to steeply sloping headlands ("0" Order channels) at their source where overland flow is concentrated. The effect of historic wildfire events on these areas is not well understood. Conjecture has it that severe fires may have triggered shallow-rapid landslides under wet conditions and some of the fan deposits we see today are a result of response to past fire. A closer review of Overwhich Creek landforms suggests this to be true. In numerous locations, Overwhich Creek has been moved laterally within the last 100 years or so by debris deposits delivered from small 1st Order channels flowing at nearly 90 degrees to the main creek channel. And,

within the last ten years, debris flows were initiated in stream headland landforms after wildfire.

Management practices have altered inputs and transport/response processes of streams. A few examples of this include:

1) Roads encroach into floodplains, disconnecting streams from their floodplain; this changes flow and nutrient dynamics.
2) Roads and bank armoring constrict channel migration.
3) Road surfaces and road drainage systems concentrate water and increase runoff.
4) Large areas of vegetation removal may increase water yield.
5) Shrub/tree removal by grazing, harvest, and roads may decrease streambank stability.
6) Impoundments change routing of water and sediment downstream.
7) Impoundments and removal of riparian shade change water temperature.
8) Levees and bridges alter response to transport patterns.
9) Altering soil characteristics and wetlands changes soil/water-storage/runoff relationships.
10) Water withdrawal affects stream transport dynamics and reduces connectivity and available habitat for aquatic species.

Before the fires of 2000, the major areas of change from the reference condition that may influence response to fire effects are: 1) impoundments such as Painted Rocks reservoir; 2) encroachment and constriction of channels; 3) loss of wetlands; 4) water withdrawal by irrigation diversion.

## 4.2.4 Effects and Implications of the Fires of 2000

### *4.2.4.1 Forest-wide Effects*

To estimate which streams may have elevated peak flows following the fire, BAER hydrologists modeled peak flow discharge using NRCS and USGS models for different precipitation events. BAER soil scientists modeled erosion and sediment delivery using the Water Erosion Prediction Project (WEPP) model to predict increases in sediment load. These calculations are based on expected increases for different burn severity and extent. As with all models, the margin of error for actual quantities is quite high, but the relative change from a control is useful for interpretation. Peak discharge was modeled for small sub-watersheds as well as larger watersheds to evaluate where runoff may be the most severe. This analysis was important to identify *where* in the watershed a runoff event may cause threat to life or property. The tables in Appendix A summarize the peak discharge and sediment yield predictions modeled by the BAER hydrologists.

A snowmelt runoff analysis was completed for all of the burned tributary streams (HUC 6 level) in the Bitterroot River drainage (Farnes, 2000a; also see the summary tables in Appendix B). Preliminary thinking is that because of the very dry soil conditions this year, the majority of the fall rain and average snowmelt will infiltrate into the soil to recharge soil moisture, and will not contribute to excess runoff. If this occurs, there is likely to be a low risk for significant runoff in 2001. It would take a heavy snow pack and a quick melt to exceed infiltration rates in most watersheds. This is not to say that some small tributary streams where more than 25 percent of the watershed burned severely will not have high flows; but this reaction should be mitigated by watershed size. In 2002, assuming an average precipitation year, peak flow increases are expected to be about 5-10 percent above what would be expected in the pre-fire condition. Widespread flooding could occur if snow accumulation exceeds 130 percent of average and melts rapidly during a warm, wet spring (Farnes, 2000b).

A watershed condition assessment conducted prior to the fires of 2000 screened watersheds for their level of altered processes due to management practices, and inherent vulnerability to disturbance (Decker et al., 1998). Several watersheds that burned are identified as having low integrity relative to natural potential condition. Table 2-1 lists the ratings for watersheds within the burned area. In the Watershed Condition column, "geomorphic integrity" is the potential for management-caused alteration of watershed processes, "water quality" rates the degree of known water quality degradation, and "geology" lists the major bedrock type, inferring natural sensitivity to disturbance. (Note: The Forest screen was a more detailed review for natural sensitivity using landtypes. This information could not be assimilated within the timeframe of this assessment, so generalized geology was used.)

Watersheds that have both potential for increased runoff and sediment delivery from fire effects and those with low "geomorphic integrity" (rating 3) are watersheds that may have longer watershed process recovery rates than watersheds with a high integrity

rating. Those watersheds that have a moderate (2) or high (1) integrity rating may provide opportunities to observe natural watershed recovery processes after fire.

Table 2-1 is intended to be a tool to help direct inventories and stream monitoring activities. Because the information was assimilated at the HUC 6 level, it does not reflect where runoff may have a significant effect on a small area. BAER surveys and analysis provided this level of analysis.

***Table 2-1. Pre fire and post-fire watershed conditions for watersheds within the burn perimeter (BAER 2000; Decker et al., 2000; Farnes, 2000a and 2000b).*** *Highlighted watersheds have a higher potential for significant runoff from major storms or snowmelt. Smaller streams within any listed watershed could have a significant runoff response if more than 25 percent of the watershed area has high severity burn. Watersheds with a "3" watershed condition rating and granitic geology have a higher potential for slower recovery effects even with lower burn area and severity. Granitic geology is indicated by "G" and metamorphic geology is indicated by "M".*

| Analysis area | Watershed name HUC 6 level | HUC 6 code | Total acres | Burn severity (% of area) | | | | Watershed condition "pre-fire" | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | High | Moderate | Low | Geomorphic integrity | Water quality | Geology |
| **Skalkaho** | Daly, Falls | 0902 | 23846 | 25 | 5 | 10 | 10 | 2 | 2 | M. |
| | S. Fk., Weasel | 0901 | 28950 | 55 | 8 | 16 | 31 | 2 | 2 | M. |
| | Bear Gulch | 0903 | 11772 | 33 | 7 | 6 | 20 | 2 | 2 | M. |
| **Sleeping Child** | L. Sleeping Child, S. Fk. L. Sleeping Child, Rogers Gul. | 0704 | 9910 | 78 | 25 | 14 | 39 | 3 | 3 | M. |
| | Mid Sleeping Child, Two Bear | 0703 | 14372 | 82 | 32 | 14 | 37 | 3 | 3 | M |
| | Switchback, Divide (N. Fk.) | 0702 | 11447 | 60 | 9 | 16 | 35 | 2 | 3 | G |
| | S. Fk. Sleeping Child | 0701 | 9914 | 46 | 14 | 3 | 29 | 3 | 3 | M |
| **Rye/Burke** | Rye, N. Fk. Rye, Lowman | 0801 | 40334 | 76 | 19 | 26 | 31 | 3 | 3 | G |
| | Burke | 0805 | 35196 | 29 | 7 | 11 | 12 | 3 | 3 | G |
| **East Fork Bitterroot** | Moose | 0401 | 15905 | 8 | 0 | 2 | 6 | 2 | 2 | G |
| | Upper(4): Carmine, Mose, Clifford | 0402 | 37036 | 63 | 21 | 14 | 28 | 1 | 1 | G |
| | Martin | 0403 | 20351 | 3 | 0 | 2 | 1 | 2 | 2 | G |
| | Meadow | 0404 | 20460 | 65 | 38 | 8 | 19 | 2 | 3 | G |
| | Mid: Bertie, Lord | 0405 | 11039 | 6 | 0 | <1 | 6 | 1 | 2 | G |
| | Tolan | 0501 | 12912 | 69 | 17 | 12 | 40 | 2 | 2 | G |
| | Camp | 0502 | 22735 | 28 | 23 | 11 | 19 | 3 | 3 | G |
| | Reimel | 0503 | 25413 | 27 | 6 | 2 | 19 | 2 | 3 | G |
| | Cameron | 0504 | 31460 | 65 | 30 | 30 | 5 | 3 | 3 | G |
| | Warm Springs | 0505 | 28799 | 43 | 9 | 5 | 30 | 1 | 2 | G |
| | Lower: Medicine Tree, Maynard, Laird | 0506 | 34083 | 89 | 38 | 12 | 40 | 2 | 3 | G |
| **West Fork Bitterroot** | Deer | 0102 | 14485 | 7 | <1 | 1 | 6 | 1 | 2 | G |
| | Hughes | 0103 | 38102 | 12 | 4 | <1 | 8 | 2 | 2 | G |
| | Overwhich | 0104 | 32134 | 39 | 12 | 6 | 21 | 3 | 2 | G |
| | Blue Joint, Little Blue Joint* | 0105 | 40043 | 14 | 7 | 3 | 4 | 1/3 * | 1/3 * | G |
| | Slate | 0106 | 11658 | 42 | 31 | 2 | 9 | 2 | 2 | G |

***Table 2-1 (continued). Pre fire and post-fire watershed conditions for watersheds within the burn perimeter** (BAER 2000; Decker et al., 2000; Farnes 2000a; Farnes, 2000b)*

| Analysis area | Watershed name HUC 6 level | HUC 6 code | Total acres | Burn severity (% of area) | | | | Watershed condition "pre-fire" | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | High | Moderate | Low | Geomorphic Integrity | Water quality | Geology |
| **West Fork Bitterroot** | Mid: Cow, Cool, Chicken | 0107 | 29639 | 44 | 15 | 3 | 26 | 1 | 2 | G |
| | Mid: Buck, Bonnie Blue | 0301 | 18283 | 2 | 0 | 1 | 1 | 3 | 3 | G |
| | Piquett | 0303 | 20645 | 15 | 2 | 7 | 7 | 3 | 3 | G |
| | Lower: Lloyd, Christen | 0305 | 22125 | 14 | 2 | 4 | 8 | 3 | 2 | G |
| **Canyon/ Blodgett/ Sheafman** | Canyon | 1004 | 15533 | 15 | 1 | 1 | 3 | 2 | 1 | G |
| | Upper Blodgett | 1005 | 17927 | 13 | 3 | 2 | 8 | 1 | 1 | G |
| | Lower Blodgett, Tamarack, Tag Alder | 1007 | 31365 | 6 | 3 | 2 | 1 | 3 | 1 | M |
| | Sheafman, Mill | 1101 | 40834 | 16 | 4 | 1 | 10 | 2 | 2 | G |
| **Salmon** | Big Harrington | 0401 | | 20 | <1 | - | 20 | 1 | 1 | G |
| | Black | | | 80 | <1 | - | 80 | 1 | 1 | G |
| | Thirsty | | | 100 | 5 | - | 95 | 1 | 1 | G |
| | Elkhorn | | | 50 | 3 | - | 47 | 1 | 1 | G |
| **Middle Selway** | Three Lakes | 0705 | | 75 | 20 | 20 | 35 | 1 | 1 | G |
| | Salamander, Flat | | | 40 | 10 | 10 | 20 | 1 | 1 | G |
| **Upper Selway** | Swet Creek | 0704 | | 50 | 15 | 20 | 15 | 1 | 1 | G |
| | Short | 0701 | | 60 | 10 | 15 | 35 | 1 | 1 | G |
| | Echo | 0304 | | 5 | <1 | <1 | 4 | 2 | 2 | G |
| | Indian | 0501 | | 1 | 0 | 0 | 1 | 2 | 2 | G |
| | Washout | 0302 | | 15 | <1 | <1 | 14 | 2 | 2 | G |
| | White Cap | 0402 | | 10 | 1 | 3 | 6 | 1 | 1 | G |
| | Swet Creek | 0704 | | 50 | 15 | 20 | 15 | 1 | 1 | G |

** Blue Joint is nearly roadless and geomorphic integrity is HIGH except for lower portion and Little Blue Joint. The wildfire was contained within Little Blue Joint, where the geomorphic integrity is LOW.*

**Stream monitoring to date.** Several streams were monitored after rainfall that occurred September 30 through October 1, 2000. Precipitation measured was similar to the magnitude of a 24-hour rain, 50-year storm (Parrett, date unknown), i.e., 0.6 inches at Darby and over 3.0 inches at Gibbons Pass. Locations monitored were: Bear Creek near Victor, Little Blue Joint Creek, Trapper Creek, Laird Creek below Gilbert Creek, Burke

Gulch near Darby, Blodgett Creek, Skalkaho Creek near Hamilton, Sleeping Child Creek, and Little Sleeping Child Creek above a private reservoir. A report by Bob Hammer (2000) found that flows ranged from a 2-year to a 10-year peak discharge. Few signs of turbidity or surface erosion were noted. These results appear to support the predictions that dry soils will soak up much of the fall rain. Only above the reservoir on Little Sleeping Child Creek were signs of flooding noted. Flows appeared to be "flashy" and no spill over the dam was evident.

**Emergency Burned Area Response.** Forest Service BAER, along with the Natural Resource Conservation Service and state and local agencies (Bitterroot Interagency Recovery Team), responded immediately to minimize potential adverse effects from the fires. Objectives of this emergency effort were to mitigate threats to human life and property and to protect watersheds from 1) losses of soil productivity from erosion and 2) deterioration of water quality from increased runoff and sedimentation **(Figure 2-1, Appendix C)**. BAER focused on federal public lands and BIRT focused on private lands. Tables 2-2 and 2-3 summarize the work completed on federal lands as of October 21, 2000. These numbers are subject to change. "Yes" in Table indicates that some or all of the work has been completed or will be completed.

An office review of prescribed treatments and implementation indicates that BAER response was complete and appropriate. The Recommendations section later in this document suggests additional issues that may need response, e.g., landslide hazard/worst case scenario threat to life and property.

***Table 2-2. Hillslope treatments completed by Burned Area Emergency Response (BAER) as of October 21, 2000.*** *(Stanich, 2000; Wildey, 2000).*

| Analysis Area | Project | Percent complete | Log erosion barrier/ contour felling (Acres) | Straw wattles (Acres) | Straw mulch (Acres) | Lop and scatter (Acres) | Aerial seeding (Acres) | Broad-cast seed (Acres) | Reforestation (Acres) | Hazard Tree Removal (Acres) |
|---|---|---|---|---|---|---|---|---|---|---|
| Skalkaho | Blacktail | 100 | 1272 | 200 | 50 | | | | | |
| | White Stallion | 100 | 366 | 26 | | | | | | |
| East Fork Bitterroot | French Basin | 100 | 1299 | 31 | 42 | | 200 | 42 | | 45 |
| Rye-Burke | Moonshine | 100 | 502 | | | 76 | | | 11 | |
| | N. Fork Rye | ~100 | 575 | | | 3 | | | 1 | |
| West Fork | West Fork | 100 | 370 | 12 | | | | 12 | | |
| Selway Complex | | n/a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | | 100 | 4384 | 269 | 92 | 79 | 0 | 54 | 12 | 45 |

***Table 2-3. Road-related treatments completed by Burned Area Emergency Response (BAER) as of October 21, 2000.*** *(Stanich 2000).*

| Analysis Area | Project Area | Miles Maintained | Culverts Replaced | Number Culvert/ Fill Removed | Number of Drain Dips | Number of Water Bar | Construct Ditch (Miles) | De-compact Surface (Miles) |
|---|---|---|---|---|---|---|---|---|
| West Fork | | 10.83 | 4 | 4 | | | 2.6 | |
| | Blue Joint | | yes | | | | | |
| Skalkaho | | 101.4 | 17 | 4 | 24 | | | |
| Rye-Burke | | 128.59 | 67 | | 3 | | | |
| East Fork | Valley | 164.1 | 61 | 34 | 15 | 5 | | 6.2 |
| | Far East | 61.75 | 13 | | 9 | 10 | | |
| Selway Complex | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | TOTAL | 466.67 | 162 | 42 | 51 | 15 | 2.6 | 6.2 |

***Table 2-4. Other treatments planned for completion by Burned Area Emergency Response*** *(BAER reports)*

| Analysis Area | Project Name or Area | Channel flotable debris removal | Tree/ shrub planting/ wattles/ log terraces | Storm patrol (road drainage maintenance during storms) | Flood warning system recom-mended | Contour scarification of water repellent soils | Channel patrol |
|---|---|---|---|---|---|---|---|
| Skalkaho/ Sleeping Child/Rye | Skalkaho, Sleeping Child | yes | yes | yes | yes | yes | |
| | Rye | | | yes | | | |
| West Fork | Fat, Taylor, Razor | | Yes | yes | | | |
| | Blue Joint | | yes | | | | |
| East Fork | Valley | | yes | | | | |
| | Far East | | | yes | yes | | yes |
| Selway Complex | | | | yes | | | |

Restoring riparian fencing to protect riparian areas from grazing is also listed in several BAER reports.

Treatments on private lands directed by BIRT included:
- Aerial grass seeding and straw mulch applications
- Log erosion barriers and contour log felling
- Constructed diversions for water and debris to protect privately-owned structures where flooding or debris flows are highly likely
- Analysis to support emergency reservoir management strategies

**Mass wasting hazard.** BAER surveys identified several areas where mass wasting could be a threat to life or property. They did not identify areas where mass wasting could be a threat to roads or produce sediment inputs to streams. This assessment developed a screen to identify locations where shallow-rapid landslides or acceleration of deep-seated landslides may occur given the right combination of soil conditions and storm events. This model is based in part on experience in Overwhich Creek, where shallow-rapid landslides occurred after fire. In addition, the screen incorporates general and local experience with landtype response (McBride, 2000). Time limited this exercise to a GIS layer screen using the burn severity map and landtypes. Unfortunately, there was not enough time to include the geologic hazard mapping by Bob Winegar (1975), since it was in hard copy form. For a complete picture including fault line and bedrock failure zones, this work should be completed.

Four thousand acres of stream headland landtypes (LT36) were burned at moderate or high severity. Response of these areas depends on weather. They have a high potential for triggering debris flows because of convergent topography and a potential for higher concentration of water-repellent soils because of soil characteristics. Map 2-1 in

Appendix D shows the percentage of watershed burned at moderate and/or high severity on high hazard landtypes (LT36, LT61, LT50).

There are about 16,000 acres of breakland landtypes (LT61) with moderate or high burn severity. Response of these areas is also weather-dependent. They have a moderate to high potential for triggering debris slides and, to a lesser degree, debris flows because of steepness of slope and shallow soils.

Concentrated road drainage diverted over fill slopes can increase potential for landslides in both of these landtypes. BAER has identified hazard roads. This assessment highlights roads with a higher risk of landslides or acceleration of deep-seated landslides. A need was identified to evaluate post-fire aerial photography for potential landslide areas with high risk to life or property.

**Stream morphology and response to fire effects.** BAER identified locations where stream flooding and channel migration may impact roads, bridges, and other structures. The BAER data is summarized by analysis area below. Additionally, a Rosgen Stream Type GIS layer has been reviewed to identify other potential threats to National Forest infrastructure.

A hazard not identified by BAER is the risk to water quality from campground sanitary stations. If these were to flood, waste could enter directly into the stream.

### *4.2.4.2 Effects in Rye/Sleeping Child/Skalkaho Analysis Area*

The Sleeping Child and Rye Creek watersheds have a greater percentage of high burn severity than the Skalkaho Creek Drainage. The Sleeping Child and Rye Creek watersheds have some of the more extensive fire severity on the Forest. Field surveys by BAER identified the following sub-watershed areas that may experience locally high discharge and place structures or roads at risk: Upper Little Sleeping Child, Two Bear, and the drainage above Sleeping Child Hot Springs.

**Pre-fire watershed condition** in the Sleeping Child and in Rye Creek watersheds is rated "3" or low integrity; watersheds in Skalkaho Creek are rated "2", or having moderate integrity. The major reason for compromised soil/hydrologic function is the number of roads and their placement and the number of stands in a state of hydrologic recovery (plantations). This suggests that management action may be necessary to aid watershed recovery. The Section 303(d) listing of impaired streams by the Montana Department of Environmental Quality, includes portions of all three watersheds.

**Mass wasting.** There is a larger extent of hazardous landtypes (LT36: stream headlands and LT61: breaklands) with moderate or high severity burn in this analysis area than other areas. These areas are shown on Map 2-2, Appendix D.

Potential areas for shallow rapid landslides follow. An asterisk (*) indicates that road systems are at risk or place the watershed at risk from landslides.

- Skalkaho
  - *Along the north-facing slope draining into the "Bearscat" and "Snow Pillow" tributaries to Daly Creek (Roads 62622, 13257, 711A, State Highway 38) (debris flow diverting Skalkaho Creek)
  - *Stumble Creek – Sections 12, 17, and 18, T4N R18W (Roads 1371, 62731)
  - A small area along mainstem Skalkaho – Sections 31, 32
  - *Newton Gulch (State Highway 38)

- Sleeping Child
  - *Several areas along the mainstem – Sections 24, 30, T4N R20W (Road 273)
  - *West Plum tributary – Section 32, T4N R19W; Sections 3, 4, T3N R19W (Road 1392)
  - Stream breaklands, particularly on south-facing aspects

- Rye
  - *North Fork Rye (Roads 321, 13251, 62430, 62430, 62575, 13229, 62544)
  - *Mainstem Rye – Sections 26, 27, T3N R20W (Road 75)

- Burke Gulch
  - Sections 34, 35, T4N R20W

Several of these areas have a series of roads crossing the landform in a "stacked" fashion. Roads may serve to concentrate water and could intensify runoff events from water-repellent soils. Also, road stream crossings in the path of debris torrents are at risk and could potentially increase the volume of sediment delivered. BAER recommendations to upsize culverts in these areas may help avoid plugging of culverts, which will prevent the road initiating debris torrents. Many of the initiation points of debris torrents may be upslope from a road.

Sleeping Child has a large amount of stream breakland landtypes (61), which are highly efficient at erosion delivery to the stream channel at their base. Mosaic patterns of burn severity will help lessen the effect. Stream breaklands occur in Skalkaho and Rye, but to a lesser extent. The granitic parent material of stream breaklands in the Rye Creek drainage poses a higher erosion hazard and thus more delivery to the stream.

The *Rosgen stream type* indicates that most of the channels will efficiently transport runoff and sediment downstream. Roads adjacent to streams are at risk of erosion. Most response channels are downstream or at the National Forest boundary. In these areas, channel migration and flooding could place at risk both roads and in-stream structures (e.g., dams, bridges, and weirs). The following areas have been identified:

| | |
|---|---|
| Little Sleeping Child | North Fork Rye Creek |
| Lower Sleeping Child | Lower Daly Creek (State Hwy 38 downstream of Road 711) |
| Lower Rye Creek | Skalkaho Creek (State Hwy 38) |

**Risks identified by BAER and BIRT are as follows:**

*Threats to life and non-federal property:*
- 1 residence/outbuilding at Newton Gulch
- State Highway 38 downstream from Forest Service Road 711
- 1 residence and pasture lands in Skalkaho Creek
- 2 homes and associated roads and drinking water supply at Sleeping Child Hot Springs
- 5 homes/outbuildings at Little Sleeping Child Creek
- 1 dam and reservoir in Little Sleeping Child Creek
- Residences in Rye mainstem, N. Fork Rye, Burke, Stella, and Mike Creeks, and road crossing at Burke Creek
- Irrigation diversion weirs
- Head gate irrigation ditch in Moonshine
- Road 311 from 2% Saddle to Rye Creek and bridge at junction with Rye Creek

BIRT has assisted landowners with an emergency reservoir management plan and is working with landowners on structural protection of their residences. The Forest Service is installing precipitation stations for an emergency flood warning system.

*Threats to Forest Service transportation system:*
- Roads 75, 273, 321, 714, 718, 720, 1371, 5600, 5783, 13214, 13216, 13217, 13217A, 13260, 13291, 13292, 13297, 62403, 62618, 1392
- Three bridges in Rye mainstem, 8 bridges in N. Fork Rye
- Trails 83, 84, 104, 105, 159, 160, 161, 164, 288, 313, 504

*Threat to water quality:*
- Ash, fine sediment, and debris filling behind dams and weirs and in irrigation ditches
- Increased fine sediment loads to important low-gradient "response" reaches in Bitterroot mainstem
- Increased sedimentation from unregulated OHV use

### *4.2.4.3 Effects in the East Fork*

Nearly half of the total watershed area in the East Fork of the Bitterroot was burned. Over 25 percent of the area burned with moderate to high severity. Watersheds with significant amounts of high severity burn with potential for high runoff events are:

- Meadow Creek (Meadow, Balsam, Dense Creeks)
- Carmine Creek
- Hope Creek
- Camp Creek
- Cameron Creek
- Robbins Gulch/Medicine Tree/Maynard/Laird/Lord Creek system
- Upper East Fork of the Bitterroot

BAER specialists' reports indicate that high flows are expected in all of these watersheds. The Far East BAER reports suggest a high degree of water repellency in soils even though duff layers and organic matter were not entirely consumed. Far East Fire Area hydrologists reported a high amount of wood in channels, which will offer a stabilizing effect when high flows occur and route sediment. They also suggest that lower-gradient segments in the upper portion of the East Fork will buffer increases in sediment in the lower East Fork by storing and slowly routing sediment over time. Because so much of the drainage area has high and moderate severity burn and water repellent soils, they recommend installation of a flood warning system. Valley Phase 1 fire area also has extensive areas of high and moderate severity burn. A flood warning system is needed for several watersheds in this area as well.

*High priority areas for flood warning are:*

- Mainstem East Fork of the Bitterroot
- Camp Creek
- Laird Creek/Medicine Tree/Robbins Gulch
- Mouth of Cameron Creek

A review of BAER's burn severity maps shows the following stream-riparian areas were burned at high severity. Recovery of vegetation will depend on pre-fire condition:

| | | | | |
|---|---|---|---|---|
| Andrews | Cameron | Hope | Praine | Swift |
| Balsam | Dense | Laird | Reimel | |
| Beam | Dickson | Maynard | Spade | |
| Blind Draw | Hart | Meadow | Sula | |

Recovery of bank stability will be highly dependent on pre-fire condition of riparian shrubs and the ability of shrubs to sprout along the banks without grazing from livestock or wildlife. BAER recommended streamside shrub planting on several streams (e.g., Reimel); additional planting needs for other streams will become apparent next spring.

**Pre-fire watershed condition** for most watersheds (see Table 2-1) has been rated at moderate or high integrity. Specialists' reports for the Far East fire also confirmed that watershed integrity was high for streams in the Upper East Fork area. These streams should route flow and sediment with a high degree of resilience.

Exceptions are Reimel, Camp, and Cameron Creeks, where low integrity ratings were given. Watershed function in Reimel Creek was already affected before the fires by grazing and a private water diversion that isolates the stream from the East Fork at low flows. Impacts on Camp Creek are grazing and channelization by Highway 93. Impacts on Cameron Creek are high road density, large areas of past timber harvest, and grazing. All of these watersheds may have less resilience and could experience increased bank erosion. Management action may be necessary to aid in recovery of riparian habitat in these areas.

Moose Creek has been identified on the Section 303(d) listing of impaired streams by the Montana Department of Natural Resources and Conservation, although Forest personnel disagree with this finding (US Forest Service letter dated June, 15, 2000).

Several road systems were identified by BAER surveys as candidates for road drainage upgrade or obliteration. Although these surveys do not replace the need to conduct a more thorough access management inventory/analysis, they are helpful in directing the need to do so.

Orphan and system roads identified by BAER Valley Phase 1 as needing access travel management evaluation and watershed mitigation include:

- Remaining fills where culverts have been removed on Road 56249, Robbins Gulch
- Lower Laird: Stacked road systems and high density roads on both sides of the drainage
- Laird Creek switchback area (NW Section 15): Skid trails and road switchback are sediment sources
- Moon Creek: high road density and stacked road systems
- Unnamed drainage, Section 3 flowing into Laird Creek: Skid trail encroaches on the channel and roads not on the FS travel system are still in place
- Blind Draw: extensively harvested and roaded. Roads are not on travel system; these old roads were largely revegetated but the fires killed the trees. Some shrubs will resprout rapidly.

**Mass wasting** has not been a common phenomenon in these watersheds in recent time, although debris slides have been observed after storm events on south-facing breaklands. The watersheds with the greatest extent of hazardous landtypes with moderate or high severity burn are: Reimel Creek, Cameron Creek, Dick Creek (Camp Creek watershed), Maynard Creek, Laird Creek, and Blind Draw. These areas are shown on Map 2-3 in Appendix D.

*Areas of highest potential for shallow rapid landslides are:*

- *Maynard Creek – Section 2, T15N R20W; Sections 24, 36, T1N R20W; Sections 13,18, T1N R18W; Section 2, T1S R18W (Roads 5740, 13368, 13370)
- *Tolan Creek headwaters – Section 32 (Road 5740)
- Reimel Creek – Sections 1, 2, T1N R19W
- *Dick Creek – Section 11, T15N R19W (Road 73543)
- *Camp Creek – Sections 17, 18, T1S R20W (Roads 73502, 73501, 73500, 73497, 106A)
- Lupine Creek – Section 26, T1S R20W
- *Laird Creek – Section 17, T1N R20W (Roads 73685, 13309, 13308, Moon Creek)

An asterisk (*) indicates road systems at risk. Several of these areas have a series of roads crossing the landform in a "stacked" fashion. Roads may serve to concentrate water and could intensify runoff events from water-repellent soils. Also, road stream crossings in the path of debris torrents are at risk and could potentially increase the volume of sediment delivered. BAER recommendations to upsize culverts in these areas may help avoid plugging of culverts, which will prevent the road initiating debris torrents. Many of the initiation points of debris torrents may be upslope from a road.

Rosgen stream type surveys on national forest lands indicate that upper reaches of streams have channels that will efficiently transport runoff and sediment to low gradient (response) reaches downstream. Response channels with high integrity will tend to store and slowly release sediment over time. Those that are lower integrity may have increased bank erosion. Important response reaches are located in the following streams: East Fork Bitterroot, Camp, East Fork Camp, Lick, Martin, Meadow, Reimel, and Swift. There are also important response channels downstream of the Forest boundary within private lands. Streambank condition is low to moderate, which may increase sediment loads by bank erosion to the East Fork.

**Risks from high runoff and/or sediment identified by BAER and BIRT are:**

*Threats to life and non-federal property:*

- State Highway 472 where in close proximity to East Fork Bitterroot
- Needle Creek: Culverts, footbridges and one home (not supported by Hydrology Report)
- Guide Creek: One culvert
- Upper East Fork: Several homes and bridges
- Valley Phase 1 area: 19 residences and 13 outbuildings
- Valley Phase 1 area: 7 miles of private roads and 36 bridges or culverts
- Ponds in Dickson Creek watershed
- Schoolman Reservoir in French Basin
- State roads: Roads 311, 73157, 73160, 73166, Sidehill Road, Lodge Road in Cameron Creek; Road 7317 and Lyman Road in Lyman Creek; Lower, Middle, and Upper Two Percent Roads in west side of French Basin; Road 13319 in Duran Creek; Road 728, 73376, Andrews Creek Road

*Threats to Forest Service transportation system and campgrounds:*

- Campgrounds: Jennings Camp
- Roads 370, 13323, 13324, 13325, 73991 in Laird; 7352, 73656, 73657 in Gilbert; Abandoned road systems in Blind Draw; Roads 5618, 13308, 13309 in Moon Creek; Roads 446, 5612, 5612a in Robbins; Roads 5612, 5767, 73213, 73215 in Medicine Tree; Road 5727 in Spring Draw/Sula Peak; Road 5730 in Crazy Creek; Roads 728 I Camp and Maynard Creeks; Road #1334,73389,73393,73391 in Waugh and Camp Creeks, Road 106 in Camp Creek; Road 311, 369, 717, 1397, 1398, 13319, 13320, 13396, 73145 in Cameron Creek. In Far East Fire Area: Roads 13337, 5790, 5785, 73609, 73614, 5762, 5740, 5782, 311, 723, 725, 73261, 73260, 73259.

*Threats to water quality deterioration:*

- Ash, fine sediment, and debris filling behind the dam, weirs and in irrigation ditches
- Increased sediment loads from highly erosive granitic soils to important low-gradient "response" reaches
- Bank erosion from peak flows
- Increased sedimentation from unregulated OHV use

*Additional stabilization work identified post-BAER, not completed, includes:*

- Log terraces to stabilize steep slope "above red house" – T1S R19E Section 3
- Log terraces on steep slopes in north Lord Draw – T1N R20W Section 2

Priorities for storm patrol are listed below (Wildey, 2000), but all road systems within the burn area should receive some level of storm monitoring.

| | | |
|---|---|---|
| Jennings Camp | Gibbons Pass Road | Laird Creek |
| Guide Creek | French Basin and Cameron Creek | |
| Andrews Creek | Medicine Tree | |

### *4.2.4.4 Effect in the West Fork*

Above Painted Rocks Reservoir, the watersheds with the greatest extent of high severity burns are West Creek, Slate Creek, Chicken Creek, Upper Overwhich Creek, Upper Slate Creek, and Little Blue Joint Creek. Below Painted Rocks Reservoir, the watersheds with the greatest extent of high severity burns are Piquett Creek and several small unnamed tributaries to the Lower West Fork near the Trapper Creek Job Corps Center. Of these, only Little Blue Joint and Piquett Creeks are accessible by road. Other watersheds burned but with light severity include Hughes Creek, Deer Creek, and Coal Creek.

The BAER hydrologist survey reports severe burns in riparian areas in Upper Slate Creek, Upper Overwhich Creek, and Chicken Creek, but large amounts of woody debris should provide a stabilizing effect for routing flow and sediment. BAER's burn severity map also indicates high severity burn in riparian areas of West Creek, Little Blue Joint and Blue Joint Creeks. Little Blue Joint and Lower Blue Joint are the only two "managed" riparian areas of the list. Without road encroachment, riparian areas are in good condition and should recover quickly. Some increases in stream temperature may occur, where large areas of shade were removed by fire

**Pre-fire watershed condition.** Geomorphic integrity is rated high in all watersheds except Piquett Creek, Lower West Fork, the lower portion of Little Blue Joint Creek, and Overwhich Creek, all of which are rated low. Lower West Fork and Piquett Creek have high road density and high harvest area; Overwhich Creek has localized high road density and naturally unstable areas in the upper watershed. The watersheds with the highest potential for lower resilience to increases in sediment and runoff are Little Blue Joint Creek, Overwhich Creek, West Creek, Coal Creek, and Piquett Creek. Painted Rocks Reservoir regulates flow and sediment in the Lower West Fork; this overshadows any fire effects.

Hughes Creek (for habitat alteration) and Overwhich Creek (for lead) are listed as impaired in Section 303(d) listing by Montana Department of Natural Resources and Conservation.

**Mass wasting hazards** are indicated in four watersheds. Severe burn on breakland landtypes (LT61) in upper Slate Creek, upper Overwhich Creek, Chicken Creek, Piquett Creek, and west slopes of Lower West Fork present a hazard for debris slides and high rates of surface erosion with delivery to the main stream channel. Severe burn on stream headlands (LT36) in Piquett Creek and one small area in Chicken Creek present a hazard for debris flows. Severe burn on a combination of a pre-existing landslides (LT50) and breaklands in Section 35, T2N R21W, presents a potential for direct delivery to the West Fork. The topographic signature on the GIS map does not indicate a deep-seated landslide. The appearance is more of debris slide or flow paths converging onto an alluvial fan. Without field reconnaissance, this interpretation is of low certainty.

*Areas of highest potential for shallow rapid landslides are:*

- *Piquett Creek: Sections 22, 26, 27
- Chicken Creek: Sections 3, 6, 36
- Upper Slate Creek: Sections 2, 34, 35
- Upper Overwhich: Sections 13, 15
- *Lower West Fork: Section 35, T2N R21W

Those areas with an asterisk (*) have road systems that are at risk or place the watershed at risk from landslides.

Rosgen stream type indicates that most sediment and runoff will be delivered to transport reaches high in the watersheds. Good watershed condition with large amounts of woody debris will help slow the transport of sediment to the lower-gradient response reaches above the reservoir in the West Fork and Lower Overwhich. Slate Creek appears to be a transport reach for most of its length and will be an efficient router of sediment to the reservoir. High flows and sediment load delivered to lower Overwhich, combined with less stable streambanks, may increase channel migration and bank erosion. This may result in a higher sediment yield being delivered to the reservoir than if this response reach was in better condition.

Several forest facilities are at risk from channel migration and high flows carrying wood debris. They are:

- Slate Creek Campground and bridge
- Bridges crossing Overwhich Creek, particularly the Road 5699 bridge

Also, water quality is threatened by potential flooding of Slate Creek Campground sanitation facilities.

### *4.2.4.5 Effects in Blodgett/Mill/Sheafman*

Overall burn severity in the large canyons (Mill Creek, Canyon Creek, and Blodgett Creek) was low. Unburned and low-severity burn areas should buffer effects from high burn severity areas. The Sheafman Creek Canyon was unburned. Smaller watersheds on the Bitterroot face (Tag Alder Creek, Cow Creek, Tamarack Creek, and Churn Creek) received a much higher concentration of moderate and severe burn. The fires within these areas consumed most of the standing trees, shrubs, grasses, and duff layer.

Several smaller watersheds are located above the community of Pinesdale (Cow Creek, Sage Creek, and Sheridan Creek). Cow Creek serves several domestic water supplies.

**Pre-fire watershed condition** in Canyon Creek, upper Blodgett Creek and Mill Creek is rated "1" or "2" (high or moderate integrity). Lower Blodgett and all the smaller watersheds are rated "3" or low integrity. The moderate and low ratings are for alteration of flow inside and outside the National Forest boundary from diversions and impoundments.

Two forest roads and several channel crossings are present within the burn perimeter.

No streams are classified as water quality impaired (Section 303d) by the Montana Department of Natural Resources and Conservation. Historic fires in the area have generally been small acreage fires with the exception of the 1919 fire. Areas of the old burn partially re-burned in 2000.

**Mass Wasting Potential.** A BAER assessment team conducting soil transects within the high burn severity areas identified varying degrees of hydrophobicity. Due to the extent and nature of these hydrophobic soils, intense rainfall or rain-on-snow events could cause higher than normal erosion and runoff to be delivered to the smaller watersheds.

All small watersheds originate in stream headland landtypes (LT36) and flow through small "inner gorge" terrain with breaklands (LT61). Burn severity in these areas is moderate or high. Because of this, the watersheds have a potential for debris slides and sediment delivery from surface erosion. Surface erosion in the inner gorge of Sage Creek and Cow Creek was observed during a field trip on October 16, 2000. Small inner gorge channels are high gradient and are not well "sized" for extreme runoff or sediment events. Debris slides and debris jam-break flood scenarios are possible.

*Potential areas with highest debris slide/flow hazard are:*

- Cow Creek
- Tamarack Creek
- Sheridan Gulch
- Sage Creek.

*Potential areas with mass erosion potential delivery to a road:*

- North-facing slope in Blodgett Canyon – Road 736
- Bitterroot front tributaries – Road 438

*Potential threat to life and property not identified by BAER:*

- Debris flow in Cow Creek may create a debris jam-break flood during an intense storm event that may have a run-out threatening homes adjacent to creek. Flash flood is also a hazard.

The Rosgen stream type map, BAER surveys, and review of the GIS topographic layer indicate steep headwater and "inner gorge" streams (A3/A4) for most of the length of the smaller watershed streams. Where these streams meet toeslopes and alluvial fans, stream type changes to B4. Both of these stream types are transport streams that move sediment and water efficiently downstream. Downstream impoundments and diversions are at risk of sediment and ash deposition and potential failure from high flows. Structures adjacent to streams are at risk to flooding and bank erosion. The steep headwater channels (A3/A4) tend to fill in with colluvium over time, and during high flows, are subject to severe bank erosion and scouring. They can carry sediment and debris rapidly downstream, plugging culverts and removing road fills. These events can happen quickly, which makes storm patrol protection a challenge.

On National Forest land, the three large streams (Canyon Creek, Blodgett Creek, and Mill Creek) are well-developed "B" type channels with small inclusions of "C" or response channel. These streams have handled high flow events from rapid snowmelt before. Aerial photography indicates that streambanks are well armored with granitic boulders, woody debris, and shrub/tree vegetation. These streams will transport runoff and sediment efficiently downstream. There may be very little change experienced from past flow-event years.

Below the National Forest boundary, Blodgett Creek, Mill Creek, Canyon Creek, Tamarack Creek, and Churn Creek are mapped as response reaches or "C" channels. Others remain transport channels. Depending on condition of stream banks, severe bank erosion may occur during high flows and channel migration may occur in the response reaches.

**Risks identified by BAER and BIRT are:**

*Threats to life and non-federal property:*

- 3 ponds and 1 irrigation ditch

*Threats to Forest Service transportation system:*

- Roads: 438, 13105 (8 undersized culverts and numerous cross drains)

*Threats to soil productivity and aquatic resources:*

- 2 miles of ATV trails between Mill and Sheafman Creeks

Straw mulch has been placed on many lower-gradient slopes above Pinesdale. This treatment will reduce soil erosion, although many sites would not have delivered sediment to streams. The treatment may also have some effect on noxious weed germination.

### *4.2.4.6 Effects in the Selway and Salmon River Drainages*

Patterns of fire location and severity are well within historic fire regimes. The BAER burn severity map indicates that no single watershed or riparian area received an extensive amount of high severity burn. The steep slopes draining directly to the Salmon River had overall low severity. The BAER report finds that long-term ecological effects are generally beneficial with the exception for potential expansion of noxious weed populations.

**Pre-fire watershed condition** is good except for impacts from the Magruder Road and some trail segments.

**Post-fire watershed condition** should resemble natural recovery from inputs of sediment, wood, and runoff. BAER found several road segments and trails that may delay natural rates of recovery. One segment of the Magruder Road passes through a drainage headland area in a watershed (Snow Water Creek) that was mapped as high severity burn. Storm patrol was recommended, with a priority placed on Road 468 from Observation Point to Kim Creek Saddle and Road 6223 (Paradise Road) from Indian Creek to Sheep Creek. BAER considered storm patrol to be of greater importance than road maintenance or road drainage enhancement. Thirty-nine miles of trail were identified as at risk of deterioration from erosion and runoff, and some will deliver minor quantities of sediment to streams. BAER installed water bars, grade dips, and other drainage treatments to reduce this hazard.

**Risks identified by BAER are:**

*Threats to life and private property:*

- Potential high water flows in campsites along streams in confined valleys

*Threats to federal property:*

- Potential loss of road and trail tread or drainage structures

*Threats of water quality deterioration:*

- No sediment increases expected above natural background except from road and trail erosion

**Other risks not mentioned by BAER:**

There is a threat of water quality degradation from flooding of campground sanitary stations and weather-treated lumber (arsenic) if they are placed within flood prone areas.

**Treatments recommended by BAER:**

- Trail drainage upgrade on trails 113 and 114 (Bitterroot National Forest portion) and #3, 7, 13, 19, 27, 74, 89, and 575 (Wilderness Complex).
- Add waterbars and tread grading to avoid concentrations of water on 1.7 miles of trails 7 and 13 between the trailhead on Montana Road 468 and Flat Creek.
- Road storm patrol and surveys for road improvement needs.

## 4.2.5 Objectives and Recommendations

### *4.2.5.1 Response to Threat of Increased Stream Flows and Sediment*

Increases in stream flow and sediment related directly to fire effects are considered "natural background" with regard to Clean Water Act regulations. Acceleration of fire effects or delay in watershed recovery caused by development is considered to be above the natural background rate. In this light, any mitigation of fire effects could be considered enhancement from a regulatory standpoint. Any mitigation of accelerated effects from development is required.

The Emergency Protection Program responds to emergency and non-emergency threats to life, property, and resources. Often the threat to life and property are within natural background of watershed processes. Unfortunately, there is no way to prevent natural landslides from occurring. We can only try to protect structures and human safety from damage or injury. BIRT/BAER have worked diligently to notify citizens "at risk" of landslide hazard or increased stream flows. Flood warning systems have been recommended and this assessment highly encourages full implementation of these systems throughout the burned area, particularly in the East Fork and Skalkaho/Sleeping Child/Rye areas.

Some natural processes are outside of agency control or legal responsibility. Watershed processes extend beyond property boundaries. Distinctions of responsibility should be made clear so that false expectations can be avoided.

Studies of historic changes in channel morphology compared to disturbance events (i.e., fire, development, and weather) for the Bitterroot River and a few major tributaries would be helpful in bringing citizens awareness of the dynamic nature of stream systems. This study could be a major force in basin-level awareness of cumulative effects on watershed processes from development.

BAER and BIRT have responded to the emergency needs to protect life and property on both public and private lands within or immediately downstream of the fire perimeter. The flood warning system that is planned for Skalkaho Creek, Sleeping Child Creek, and Upper East Fork will provide some level of warning to residents. It was unclear in the BAER reports whether other drainages will also benefit from this warning system. Other drainages that should receive flood warning alerts are: Laird Creek and associated tributaries to the East Fork; Cameron Creek; Rye Creek; and tributaries flowing from the Bitterroot front (Tag Alder, Cow, Tamarack, etc). Closures of roads adjacent to streams also should be considered.

BAER conducted an extensive survey to locate water-repellent soils and other areas that could increase sediment or runoff, such as firelines, trails, and roads. Treatments to reduce hazards have been placed in locations where the potential risk is the greatest. Upsizing culverts has in effect "storm proofed" road drainage systems, provided the

culverts continue to function. Some BAER recommendations were further analyzed and modified based on local experience. This is not to say that all hazards have been mitigated, but it is reasonable to believe that the highest risks, particularly to human life and property, have been addressed.

This assessment has, however, found a few omissions and has recommended additional action where needed. Specifically, these are:

1) A detailed evaluation of landslide hazard/risk to property or life using post-fire aerial photography.
2) Adding to the flood alert system the entire length of the East Fork Bitterroot and the Laird/Medicine Tree/Robbins Gulch watersheds.
3) Conducting storm patrol on roads in all high/moderate severity burn areas.

Since fire's effects on streamflow and sediment depend on weather, it is difficult to predict with certainty where damage to structures or danger to life may occur. Preparedness is advisable, but for the worst case or something less? Our recommendation is to know where "at risk" Forest Service infrastructure and areas are located, conduct storm patrol monitoring, and prepare to implement response plans for a "worst case" scenario. Priorities for future watershed protection work will be determined based mainly on surveys conducted after or during storm events.

### *4.2.5.2 Setting Priorities for Watershed Recovery Activities*

Appendix G of the Forest Plan lists high priority watersheds on which to focus mitigation efforts. The Intermountain West Watershed Reconnaissance (IWWR) also provides a current review of watershed condition. Both of these sources are instructive on which watersheds may need additional efforts to assure natural rates of recovery from wildfire effects. A sense of priority has developed from reviewing these sources, recommendations from BAER specialists, and through discussions with local specialists (Wildey, Decker, Hammer, Jakober, 2000).

In the following watersheds, **access and travel management analysis** addressing road density, road location, and orphan roads could prove to be beneficial in aiding watershed recovery:

- Rye – road density, road drainage and road location in and outside of burned area (includes federal and private roads)
- Skalkaho – road density, State Highway 38, orphan road in Newton Gulch
- Sleeping Child – road density and location in burned area; County Road
- Cameron – high road density; road drainage; road location (federal, state, private)
- Robbins Gulch/Medicine Tree – road density
- Laird – road density; orphan roads
- Little Blue Joint
- West and Coal Creeks

Availability of the _Land Systems Inventory (LSI)_ for access travel management would greatly improve efficiency and effectiveness of the analyses and provide focus for road/landform/watershed effect relationships. Making the LSI available as GIS layers should be a priority.

The importance of **storm patrol and increased vigilance for road maintenance** cannot be overstated. This is one of the most effective means of reducing road-related impacts. After fire, sediment delivery from roads can increase significantly from 1) increased runoff delivered to and from road treads, 2) road cut erosion filling ditches and diverting runoff, causing hillslope erosion, and 3) road drainage directly onto bare, burned slopes. Cleaning out plugged culverts and debris above culverts, maintaining ditches, and using sediment control devices to trap road sediment prior to entering a live stream course are all functions of storm patrol. This is also an excellent opportunity to observe whether road drainage systems are functioning and meeting current Best Management Practices. The mass wasting hazard map (made from LSI) may be instructive on potential hazard areas. Storm patrol should focus on Skalkaho Creek, Sleeping Child Creek, Little Sleeping Child Creek, the Selway Complex, Camp Creek, Cameron Creek, Slate Creek bridge, lower Overwhich Creek Bridge, Jennings Camp, Guide Creek, Andrews Creek, Gibbons Pass road, French Basin, Laird Creek, North Fork Rye, and Medicine Tree Creek (Wildey, 2000). Storm patrol also needs to cover all accessible roads that transect or are above moderate or severe burn areas. Road maintenance engineers should be involved in developing a storm patrol plan, as they are familiar with existing "problem areas".

***Table 2-5. Miles of road that transect moderate and high severity burn and miles of road vulnerable effect from or on high landslide/erosion hazard landtypes***

| Analysis Area | Miles of road in moderate/ high severity | Miles of road in mod/severe burn and high hazard landtypes |
|---|---|---|
| Skalkaho/Sleeping Child/Rye | Open: 192<br>Closed*: 34 | 13 |
| Blodgett/Sheafman | Open: 7<br>Closed*: 1 | 1 |
| East Fork (Far East & Valley) | Open: 152<br>Closed*: 57 | 8 |
| Selway | 3 (BAER estimated 27 miles needed) | no LT mapping available |
| West Fork | Open: 15<br>Closed*: 16 | 1 |

**Closed roads with moderate/high severity may or may not be closed after fire response activities. They may or may not have effective drainage or stability.*

Because of natural variability in landscapes, weather, and burn severity, it is difficult to predict with certainty whether there will be large-scale surface erosion or if mass wasting will exceed standards. Standards may be for protection of visual quality, high value fisheries, domestic water supply, soil productivity or other management related values. The _Watershed Improvement Needs_ inventory process (WIN) is designed to collect

and interpret erosion sources for their relative impact to defined standards. This assessment recommends that WIN be used to inventory the burn area in the first year and following years after severe storm events. WIN inventories could be applied at different levels of intensity ranging from aerial reconnaissance to field survey. A data management system tied to GIS would provide the baseline documentation for monitoring. Aerial photography of the burned area each year for several years would greatly economize this effort.

**Monitoring** seems to be implicit after wildfire. The first priority is to monitor *implementation* of BAER to assure that treatments have been implemented as prescribed or altered with good rationale. The second priority is to monitor *effectiveness* of treatments. That is, were the BAER treatments, predictions, and other actions in response to the fire effective in reducing the threat to life, property, and resources? Stream monitoring ranging from qualitative to quantitative (discharge, sediment, cross-section changes) contributes to both effectiveness and validation monitoring (are streams responding to and recovering from fire effects in a predicted manner, i.e., inside or outside our concept of natural range of variability?).

The fires of 2000 provide opportunities to collaborate with research and other agencies in conducting controlled experiments and true *validation* monitoring. Some suggestions along this line are:

1) Infiltration and runoff from high burn severity and compacted soils
2) Infiltration and runoff from high burn severity and high road density
3) Reduction of erosion, runoff, and sediment delivery of by various BAER treatments

### *4.2.5.3 Management Needs and Opportunities*

✓ Complete BAER work planned and not yet completed:

- East Fork Analysis Area
  Log terraces north of Lord Draw (Sec 2, T1N R20W)

- West Fork Analysis Area
  Log terraces/wattles/shrub planting on steep slopes in Little Blue Joint Creek

- Area-wide
  Complete fill stabilization and restore gravel road surface in culvert replacement areas.
  Evaluate where shrub planting will restore long-term stability or provide protection from sediment delivery.

✓ Storm patrol, on roads.

- ✓ Increase vigilance on maintaining road drainage function within burned areas.
- ✓ Re-evaluate access and travel management needs and opportunities to reduce watershed impacts in all watersheds affected by the fires of 2000.
- ✓ Complete the Land Systems Inventory and make available to users (access and travel management, road maintenance prioritization, watershed recovery predictions, WATSED, WEPP modeling).
- ✓ Pump outhouses in campgrounds adjacent to streams prior to winter to avoid water quality degradation from flooding. Work with state agencies to do the same.

### *4.2.5.4 Monitoring and Inventory Needs and Opportunities*

- ✓ Conduct WIN inventories in 2001 and 2002 to locate actively delivering hillslopes and road erosion with significant threat to watershed recovery or other management standards.
- ✓ Monitor implementation of BAER treatments.
- ✓ Conduct effectiveness monitoring of BAER treatments, other response activities, runoff/sediment forecasting, watershed condition ratings, i.e., integrity after fire (IWWR).
- ✓ Stream watch monitoring ranging from qualitative to quantitative
  - There is a great opportunity to compare pre-fire observations with post-fire response by re-establishing USGS gauging stations in key tributaries. Recommend measuring for at least 3 to 10 years.
  - Videography is a cost effective and time conservative method of qualitative monitoring watershed recovery. (Tyler mounted video with GPS and helicopter)
- ✓ Conduct a historic review of channel migration and changes in morphology compared to significant disturbance events, e.g., weather, development, and fire, for the mainstem Bitterroot and several tributaries.

#### *4.2.5.5 Opportunities to Work with Citizens, Agencies, and Research*

- ✓ Collaborate on design and funding of effectiveness and validation monitoring
- ✓ Work with state and private landowners at a watershed level to reduce impacts from roads
- ✓ Work with state and private to cooperatively fund stream monitoring
- ✓ Conduct controlled studies to further assess the effectiveness of BAER and other post-fire treatments in reducing sediment
- ✓ Conduct controlled studies to assess the effect of salvage harvest on water resources. Current information of the effects of salvage harvest on water resources is lacking.
- ✓ Conduct quantitative stream flow and sediment yield studies in drainages that burned at different severities and with and without salvage harvest

### 4.2.6 Regulations and Direction

The Forest Plan's goal for watershed management is to "maintain the present high level of water quality and the current fish habitat capacity throughout the Forest", and specifically to:

- Upgrade drainage and place surfacing on some roads
- Use new sediment control methods on new construction
- Maintain or improve large woody debris in stream channels for aquatic habitat and channel function
- Limit road density

A special management emphasis area (MA3b) protects riparian areas along all major tributaries of the Bitterroot River. Restrictions on grazing, roads, and timber harvest protect soil, water, and riparian vegetation.

Other regulatory or legal requirements that direct watershed management are:

- Section 208 of the 1972 amendments to the Federal Water Pollution Control Act (Public Law 92-500), which specifically mandates identification and control of nonpoint-source pollution resulting from silvicultural activities.

- Endangered Species Act and Interagency Aquatic Conservation Strategies

- Section 403 of Title IV of the Agricultural Credit Act of 1978 (16 U.S.C. 2201-2205) and Title 7, Code of Federal Regulations, Part 624 (7 CFR 624), the Emergency Watershed Protection Program.

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## Appendix A. Run-off and Sediment Prediction Tables Modeled by BAER Hydrologists

**Table A-1: Run-off Rates (Cubic Feet Per Second)For Small Watersheds (< 3000 ACRES) within the Fire 2000 Analysis Area Modeled by BAER hydrologists using NRCS Runoff Curves based on 10 year, 24 hour storm.**

| Analysis Area | Acres | Burn Severity % | | | Unburned 2000 24 hour | | | Burned 9/2000 24 hour | | | 1 year 9/2001 24 hour | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | High | Mod | Low | 2 year | 5 year | 10 year | 2 year | 5 year | 10 year | 2 year | 5 year | 10 year |
| **SKALKAHO/SLEEPING CHILD/RYE** | | | | | | | | | | | | | |
| **Daly Trib** | 480 | 58 | 34 | 8 | 1 | 3 | 7 | 73 | 130 | 211 | 55 | 100 | 162 |
| **Dig 1 (binwall)** | 289 | 2 | 69 | 29 | 0 | 0 | 5 | 2 | 5 | 22 | 0 | 0 | 5 |
| **Dig 2 (Two Bear)** | 1228 | 48 | 13 | 39 | 1 | 7 | 18 | 10 | 28 | 89 | 6 | 16 | 53 |
| **Dig 3 (Coyote Meadow)** | 1385 | 6 | 67 | 27 | 2 | 8 | 20 | 11 | 32 | 101 | 2 | 8 | 33 |
| **Dig 4 (X drain)** | 350 | 96 | 3 | 1 | 1 | 2 | 5 | 99 | 126 | 214 | 82 | 125 | 160 |
| ***Sleep Child Hot Sprgs.** | 2079 | 64 | 23 | 13 | 2 | 11 | 30 | 208 | 356 | 603 | 138 | 302 | 451 |
| **Newton Gulch** | 740 | 11 | 27 | 62 | 18 | 65 | 135 | 48 | 108 | 204 | 39 | 93 | 181 |
| ***Schall Draw** | 100 | 50 | 50 | 0 | 1 | 4 | 13 | 29 | 45 | 66 | 10 | 20 | 30 |
| **Rye Creek/Moonshine Gulch** | 21 | 100 | | | | | | 10 | 14 | 20 | 8 | 12 | 17 |
| **Rye Creek/Moonshine Gulch** | 61 | 100 | | | | | 1 | 20 | 29 | 39 | 16 | 25 | 34 |
| **Rye Creek/Moonshine Gulch** | 16 | 100 | | | | | | 7 | 11 | 15 | 6 | 9 | 13 |
| | | | | | **25 year** | **50 year** | **100 year** | **25 year** | **50 year** | **100 year** | **25 year** | **50 year** | **100 year** |
| ***Sleeping Child Hot Sprgs.** | 2079 | 64 | 23 | 13 | 44 | 84 | 132 | 688 | 898 | 1058 | 465 | 569 | 691 |
| ***Schall Draw** | 100 | 50 | 50 | 0 | 18 | 25 | 35 | 75 | 87 | 105 | 43 | 54 | 70 |
| **BLODGETT/SHEAFMAN** | | | | | | | | | | | | | |
| **Lower Sheafman** | 139 | ~100 | | | 0 | 2 | 3 | 16 | 31 | 42 | 3 | 7 | 13 |
| **Middle Sheafman** | 104 | ~100 | | | 0 | 1 | 2 | 17 | 28 | 34 | 4 | 10 | 15 |
| **Upper Sheridan** | 84 | ~100 | | | 1 | 3 | 4 | 18 | 21 | 38 | 2 | 5 | 9 |
| **Cow** | 386 | ~100 | | | 1 | 4 | 7 | 44 | 74 | 101 | 12 | 29 | 48 |
| **Cow Tributary** | 138 | ~100 | | | 0 | 2 | 3 | 5 | 14 | 21 | 2 | 5 | 8 |
| **Upper Cow Tributary** | 35 | ~100 | | | 0 | 0 | 1 | 1 | 1 | 2 | 0 | 1 | 1 |
| **Lower Sage** | 97 | ~100 | | | 0 | 1 | 2 | 11 | 22 | 29 | 2 | 5 | 9 |
| **Upper Sage** | 85 | ~100 | | | 0 | 1 | 2 | 10 | 19 | 23 | 3 | 7 | 12 |

Table A-1, Continued

| Analysis Area | Acres | Burn Severity % | | | Unburned 2000 24 hour | | | Burned 9/2000 24 hour | | | 1 year 9/2001 24 hour | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | High | Mod | Low | 2 year | 5 year | 10 year | 2 year | 5 year | 10 year | 2 year | 5 year | 10 year |
| **EAST FORK BITTERROOT** | | | | | | | | | | | | | |
| **Robbins Trib. (s)** | 18 | 100 | | | | | | 8 | 12 | 17 | 7 | 10 | 14 |
| **Robbins Trib. (l)** | 42 | 100 | | | | | | 16 | 24 | 34 | 14 | 21 | 29 |
| **Bear Gulch** | 43 | 100 | | | | | 1 | 15 | 22 | 30 | 13 | 19 | 26 |
| **Robbins Trib.** | 23 | 100 | | | | | | 11 | 16 | 21 | 8 | 13 | 18 |
| **below Doran Point** | 104 | | | 100 | | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 |
| **Medicine Tree Creek** | 140 | | 95 | 5 | | 1 | 2 | 21 | 33 | 48 | 8 | 17 | 29 |
| **Entire Robbins Gulch** | 1900 | 30 | 40 | 30 | 3 | 12 | 26 | 85 | 160 | 255 | 49 | 115 | 224 |
| **Medicine Tree (s)** | 13 | 100 | | | | | | 5 | 7 | 10 | 4 | 6 | 9 |
| **Entire Dickson Creek** | 1726 | 70 | | 30 | 3 | 12 | 25 | 107 | 194 | 292 | 92 | 181 | 260 |
| **Billy Goat Gulch** | 233 | | 45 | 55 | | 2 | 4 | 2 | 8 | 22 | 1 | 3 | 6 |
| **Medicine Tree (l)** | 138 | 100 | | | 1 | | | 36 | 52 | 70 | 29 | 43 | 63 |
| **Medicine Tree (l)** | 219 | 100 | | | 1 | | | 48 | 68 | 96 | 42 | 60 | 83 |
| **Blind Draw** | 562 | 80 | | 20 | 1 | 4 | 8 | 57 | 99 | 148 | 50 | 88 | 140 |
| **Whiskey Gulch** | 311 | | 20 | 80 | 1 | 2 | 5 | 2 | 4 | 12 | 2 | 4 | 10 |
| **Medicine Tree** | 49 | 100 | | | | | | 15 | 21 | 29 | 12 | 17 | 24 |
| **Dickson Creek** | 1039 | 45 | | 55 | 2 | 7 | 15 | 19 | 56 | 107 | 19 | 56 | 107 |
| **Franklin Gulch** | 497 | 50 | 30 | 20 | 1 | 3 | 7 | 53 | 96 | 139 | 40 | 76 | 119 |
| **North Fork** | 1681 | 10 | 75 | 15 | 3 | 11 | 23 | 118 | 216 | 302 | 71 | 139 | 225 |
| **Cameron Creek** | 2369 | 10 | 60 | 30 | 4 | 16 | 32 | 85 | 141 | 205 | 44 | 94 | 176 |
| **above Lyman Creek** | 23 | | 100 | | | | | 7 | 12 | 15 | 3 | 5 | 10 |
| **above Lyman Creek** | 30 | | 100 | | | | | 9 | 15 | 20 | 4 | 7 | 13 |
| **above Lyman Creek** | 374 | | 100 | | 1 | 3 | 5 | 56 | 88 | 123 | 24 | 59 | 78 |
| **above Lyman Creek** | 892 | | 80 | 20 | 2 | 6 | 12 | 24 | 65 | 104 | 2 | 7 | 14 |
| **Entire Hart Creek** | 2445 | 50 | 35 | 15 | 4 | 16 | 33 | 162 | 286 | 413 | 133 | 221 | 391 |
| **above Lyman Creek** | 52 | | 100 | | | | 1 | 14 | 22 | 31 | 6 | 12 | 17 |
| **above Lyman Creek** | 74 | | 100 | | | 1 | 1 | 19 | 32 | 44 | 8 | 18 | 25 |
| **above Lyman Creek** | 467 | | 100 | | 1 | 3 | 7 | 71 | 114 | 154 | 32 | 68 | 102 |
| **Laird Creek** | 28 | 100 | | | | | | 12 | 19 | 26 | 11 | 17 | 22 |
| **Laird Creek** | 134 | 100 | | | 3 | 10 | 21 | 39 | 57 | 78 | 34 | 49 | 67 |
| **Laird Creek** | 462 | 100 | | | 1 | 3 | 7 | 120 | 169 | 242 | 100 | 155 | 206 |
| **Laird Creek** | 70 | | 100 | | | | 1 | 16 | 26 | 37 | 8 | 15 | 21 |

Table A-1, Continued

| Analysis Area | Acres | Burn Severity % | | | Unburned 2000 24 hour | | | Burned 9/2000 24 hour | | | 1 year 9/2001 24 hour | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EAST FORK BITTERROOT(cont)** | | High | Mod | Low | 2 year | 5 year | 10 year | 2 year | 5 year | 10 year | 2 year | 5 year | 10 year |
| **Spring Gulch** | 47 | | | 100 | | | 1 | | | 1 | | | 1 |
| **above Spring Gulch** | 65 | 100 | | | | | 1 | 26 | 38 | 52 | 21 | 32 | 44 |
| **Laird Creek** | 51 | 100 | | | | | 1 | 16 | 23 | 32 | 13 | 20 | 27 |
| **above Laird Creek** | 22 | 100 | | | | | | 9 | 10 | 14 | 6 | 9 | 12 |
| **Laird Creek** | 115 | 100 | | | | 1 | 2 | 36 | 47 | 75 | 30 | 45 | 63 |
| **Entire Moon Creek** | 2409 | 50 | | 50 | 5 | 16 | 34 | 62 | 146 | 254 | 53 | 134 | 234 |
| **East of Moon Creek** | 143 | 15 | 70 | 15 | | 1 | 2 | 19 | 31 | 51 | 11 | 22 | 36 |
| **Moon Creek** | 512 | 30 | | 70 | 1 | 4 | 8 | 7 | 14 | 39 | 5 | 14 | 37 |
| **Lord Craw** | 598 | 30 | | 70 | 1 | 4 | 9 | 6 | 17 | 43 | 17 | 45 | 91 |
| **Moon Creek** | 140 | | | 100 | | 1 | 2 | | 1 | 2 | | 1 | 2 |
| **above Moon Creek** | 79 | | | 100 | | 1 | 1 | | 1 | 1 | | 1 | 1 |
| **Maynard Creek** | 229 | 100 | | | | | 1 | 21 | 30 | 41 | 17 | 26 | 35 |
| **Crazy Creek** | 489 | 50 | | 50 | 1 | 4 | 8 | 17 | 46 | 83 | 17 | 37 | 74 |
| **Maynard Creek** | 229 | 100 | | | 0 | 2 | 4 | 63 | 94 | 127 | 54 | 79 | 108 |
| **above Maynard Creek** | 92 | 100 | | | | 1 | 1 | 32 | 46 | 64 | 26 | 41 | 54 |
| **between Camp and Reimel** | 63 | 100 | | | | | 1 | 25 | 36 | 50 | 21 | 31 | 43 |
| **Entire Waugh Creek** | 1718 | 20 | 70 | 10 | 3 | 12 | 24 | 146 | 249 | 363 | 92 | 170 | 259 |
| **below Waugh Creek** | 350 | 60 | | 40 | 1 | 3 | 5 | 17 | 47 | 77 | 8 | 27 | 58 |
| **Entire Dick Creek** | 1654 | 60 | 10 | 30 | 3 | 11 | 23 | 109 | 186 | 294 | 66 | 141 | 233 |
| **Dick Creek** | 41 | | 100 | | | | 1 | 6 | 10 | 17 | | 1 | 3 |
| **Dick Creek** | 129 | | 100 | | | 1 | 2 | 14 | 31 | 44 | 1 | 3 | 7 |
| **Entire Diggins Creek** | 868 | 30 | | 70 | 2 | 6 | 12 | 8 | 15 | 51 | 7 | 15 | 40 |
| **Andrews Creek** | 728 | 10 | 45 | 45 | 1 | 2 | 5 | 11 | 32 | 55 | 4 | 17 | 38 |

Table A-2: Overland Flow Rates and Erosion Potential, Based on 10 Year, 24 Hour Storm Event (Derived using the WEPP Model)

| Fire Name | Design Storm Recurrence Interval | Design Storm Magnitude (inches) | Design Flow ($cfs/mi^2$) | Estimated Reduction In Infiltration (%) | Adjusted Design Flow ($cfs/mi^2$) | Erosion Potential ($yds^3/mi^2$) | Erosion Potential (tons/acre) | Sediment Potential ($yds^3/mi^2$) | Sediment Potential (tons/acre) |
|---|---|---|---|---|---|---|---|---|---|
| **Valley Phase 1** | 10year-24hour | 2.5 | 67.0 | 20 | 53.4 | 3180.0 | 5.89 | 1150 | 2.13 |
| **Skalkaho** | 10year-24hour | 2.5 | 11.0 | 40 | 23.0 | 2618.5 | 4.85 | 1787 | 3.31 |
| **Valley Far East** | 10year-24hour | 2.5 | 13.5 | 8 | 17.4 | 3503.3 | 6.49 | 2746 | 5.09 |
| **Blodgett** | 10year-24hour | 3.0 | 167.0 | 20 | 134.0 | 2105.6 | 3.90 | 316 | 0.59 |
| **Rye/Burke** | 10year-24hour | 2.5 | 9.0 | 20 | 67.0 | 2861.0 | 5.30 | 631 | 5.30 |

## Appendix B. Farnes Runoff Prediction Tables (taken from Farnes, 2000a)

Table B-1: Estimated pre-fire runoff and increase due to 2000 fires and percentage of the drainage with moderate and severe burn for 83 hydrologic units (HUC's) in the Bitterroot River drainage.

| Sixth Code HUC | HUC Name | Drainage Area Sq. Mi. | 1961-1990 Avg Ann Precip, in. | Pre-Fire Runoff 1000's Ac. Ft. | Increase In Runoff Ac. Ft. | Percent Increase Runoff | Burned Area Acres | Percent HUC Burned |
|---|---|---|---|---|---|---|---|---|
| 0101 | Upper West Fk. * | 54.7 | 40.2 | 37.9 | | | | |
| 0102 | Deer Creek | 22.6 | 41.1 | 16.0 | 13 | 0.1 | 106 | 0.1 |
| 0103 | Hughes | 59.5 | 36.0 | 35.8 | 348 | 1.0 | 1462 | 3.8 |
| 0104 | Overwhich | 50.2 | 34.8 | 28.5 | 1162 | 4.1 | 5679 | 17.6 |
| 0105 | Blue Joint | 62.6 | 38.4 | 40.7 | 694 | 1.7 | 3888 | 9.7 |
| 0106 | Slate | 18.2 | 35.1 | 11.1 | 904 | 8.2 | 3852 | 33.0 |
| 0107 | Little Blue Joint | 46.3 | 32.2 | 23.2 | 1054 | 4.5 | 5190 | 17.5 |
| | | | | | | | | |
| 0201 | Sheephead * | 19.4 | 43.8 | 15.6 | | | | |
| 0202 | Watchtower * | 16.9 | 51.1 | 17.7 | | | | |
| 0203 | Little West Fork* | 24.3 | 55.7 | 29.1 | | | | |
| 0204 | Nez Perce * | 37.4 | 38.6 | 25.4 | | | | |
| | | | | | | | | |
| 0301 | Beavertail | 28.6 | 28.2 | 11.6 | 29 | 0.2 | 144 | 0.8 |
| 0302 | Boulder * | 20.9 | 74.1 | 38.2 | | | | |
| 0303 | Piquett | 32.3 | 30.4 | 14.8 | 201 | 1.4 | 1677 | 8.1 |
| 0304 | Trapper * | 28.4 | 63.4 | 42.0 | | | | |
| 0305 | Baker | 34.6 | 31.6 | 17.4 | 83 | 0.5 | 1378 | 6.2 |
| | | | | | | | | |
| 0401 | Moose | 24.9 | 35.7 | 16.5 | 98 | 0.6 | 310 | 1.9 |
| 0402 | Upper East Fork | 57.9 | 37.1 | 38.7 | 3063 | 7.9 | 12817 | 34.6 |
| 0403 | Martin | 31.8 | 34.7 | 20.4 | 104 | 0.5 | 324 | 1.6 |
| 0404 | Meadow | 32.0 | 34.7 | 19.8 | 2406 | 12.1 | 9422 | 46.1 |
| 0405 | Bertie Lord | 17.2 | 27.5 | 7.1 | 7 | 0.1 | 34 | 0.3 |
| | | | | | | | | |
| 0501 | Tolan | 20.2 | 32.0 | 11.6 | 749 | 6.4 | 3718 | 28.8 |
| 0502 | Camp | 35.5 | 29.2 | 17.2 | 1094 | 6.4 | 7716 | 33.9 |
| 0503 | Middle East Fork | 39.7 | 26.2 | 15.4 | 320 | 2.1 | 1997 | 7.9 |
| 0504 | Cameron | 49.2 | 24.9 | 16.7 | 2127 | 12.8 | 18916 | 60.1 |
| 0505 | Warm Springs | 45.0 | 32.0 | 25.9 | 750 | 2.9 | 4008 | 13.9 |
| 0506 | Lower East Fork | 53.3 | 23.5 | 16.1 | 1680 | 10.4 | 16765 | 49.2 |
| | | | | | | | | |
| 0601 | Lost Horse * | 43.4 | 64.4 | 92.0 | | | | |
| 0602 | South Fk Lost Horse * | 31.2 | 54.2 | 55.7 | | | | |

* Unburned Drainages

Table B-1, Continued

| Sixth Code HUC | HUC Name | Drainage Area Sq. Mi. | 1961-1990 Avg Ann Precip, in. | Pre-Fire Runoff Ac. Ft. | Increase In Runoff Ac. Ft. | Percent Increase Runoff | Burned Area Acres | Percent HUC Burned |
|---|---|---|---|---|---|---|---|---|
| 0701 | Upper Sleeping Child | 15.5 | 34.8 | 10.8 | 304 | 2.8 | 1678 | 16.9 |
| 0702 | Divide | 17.9 | 34.1 | 12.3 | 650 | 5.3 | 2832 | 24.7 |
| 0703 | Mid Sleeping Child | 22.5 | 28.2 | 11.2 | 995 | 8.9 | 6597 | 45.9 |
| 0704 | Little Sleeping Child | 15.5 | 22.6 | 4.9 | 504 | 10.4 | 3889 | 39.2 |
| 0705 | Lower Sleeping Child | 20.7 | 20.8 | 5.3 | 211 | 4.0 | 1583 | 12.0 |
| | | | | | | | | |
| 0801 | Rye | 63.0 | 24.9 | 22.8 | 2332 | 10.2 | 18067 | 44.8 |
| 0802 | Chaffin * | 13.6 | 63.9 | 23.6 | | | | |
| 0803 | Tin Cup * | 42.2 | 68.7 | 82.1 | | | | |
| 0804 | Rock * | 57.3 | 62.0 | 101.6 | | | | |
| 0805 | Upper Bitterroot | 55.0 | 21.0 | 15.7 | 699 | 4.4 | 6450 | 18.3 |
| 0806 | Camas-Ward | 53.2 | 29.0 | 30.8 | 47 | 0.2 | 633 | 1.0 |
| | | | | | | | | |
| 0901 | Upper Skalkaho | 45.2 | 33.0 | 31.3 | 1714 | 5.5 | 6880 | 23.8 |
| 0902 | Daly | 37.3 | 34.9 | 28.1 | 964 | 3.4 | 3553 | 14.9 |
| 0903 | Middle Skalkaho | 34.0 | 26.4 | 8.5 | 214 | 2.5 | 1598 | 13.6 |
| 0904 | Lower Skalkaho | 16.3 | 17.3 | 2.6 | 19 | 0.7 | 189 | 1.8 |
| | | | | | | | | |
| 1001 | Saint Clair-Gird* | 32.3 | 28.0 | 17.3 | | | | |
| 1002 | Roaring Lion * | 25.0 | 57.4 | 48.5 | | | | |
| 1003 | Sawtooth * | 23.7 | 52.8 | 41.6 | | | | |
| 1004 | Canyon | 24.3 | 32.9 | 19.0 | 129 | 0.7 | 259 | 1.7 |
| 1005 | Blodgett | 28.0 | 53.3 | 52.3 | 221 | 0.4 | 698 | 3.9 |
| 1006 | Willow * | 40.2 | 26.4 | 19.4 | | | | |
| 1007 | Lower Gird | 49.0 | 17.1 | 7.6 | 558 | 7.3 | 1664 | 5.3 |
| | | | | | | | | |
| 1101 | Mill-Fred Burr | 63.8 | 44.1 | 90.3 | 822 | 0.9 | 2201 | 5.4 |
| 1102 | Bear * | 28.0 | 52.1 | 50.4 | | | | |
| 1103 | Sweathouse * | 24.8 | 41.1 | 27.7 | | | | |
| 1104 | Birch * | 64.5 | 16.6 | 8.8 | | | | |
| 1105 | Willoughby-Spooner * | 46.0 | 17.4 | 7.5 | | | | |

* Unburned drainages

Table B-1, Continued

| Sixth Code HUC | HUC Name | Drainage Area Sq. Mi. | 1961-1990 Avg Ann Precip, in. | Pre-Fire Runoff Ac. Ft. | Increase In Runoff Ac. Ft. | Percent Increase Runoff | Burned Area Acres. | Percent HUC Burned |
|---|---|---|---|---|---|---|---|---|
| 1201 | Big | 35.1 | 49.1 | 59.2 | | | | |
| 1202 | McCalla-Sharrott | 17.0 | 34.2 | 13.2 | | | | |
| 1203 | Kootenia | 31.6 | 49.8 | 60.4 | | | | |
| 1204 | Upper Burnt Fork | 40.2 | 36.5 | 22.6 | | | | |
| 1205 | Middle Burnt Fork | 33.3 | 27.9 | 17.5 | | | | |
| 1206 | Lower Burnt Fork | 51.2 | 16.5 | 6.7 | | | | |
| | | | | | | | | |
| 1301 | Bass | 14.3 | 50.7 | 25.2 | | | | |
| 1302 | Ambrose | 20.8 | 19.3 | 4.7 | | | | |
| 1303 | Threemile | 51.8 | 19.4 | 11.9 | | | | |
| 1304 | Sweeney | 19.1 | 51.3 | 33.6 | | | | |
| 1305 | Larry-Brooks-Dry | 46.9 | 18.0 | 8.8 | | | | |
| 1306 | Eightmile | 28.2 | 22.2 | 9.3 | | | | |
| 1307 | One Horse | 14.6 | 44.0 | 16.6 | | | | |
| 1308 | Carlton | 25.7 | 31.5 | 17.5 | | | | |
| 1309 | Woodchuck-Davis | 47.1 | 17.6 | 7.8 | | | | |
| | | | | | | | | |
| 1401 | West Fork Lolo | 16.6 | 39.4 | 10.5 | | | | |
| 1402 | East Fork Lolo | 31.9 | 43.8 | 23.9 | | | | |
| 1403 | Granite | 20.3 | 48.8 | 18.4 | | | | |
| 1404 | Howard | 19.4 | 33.2 | 9.3 | | | | |
| 1405 | Martin-Cloudburst | 22.0 | 31.6 | 9.7 | | | | |
| 1406 | Butte | 17.8 | 37.4 | 10.6 | | | | |
| 1407 | South Fork Lolo | 38.8 | 47.8 | 33.0 | | | | |
| 1408 | Bear-Woodman | 55.2 | 35.5 | 29.0 | | | | |
| 1409 | Morman-Sleeman | 50.5 | 27.9 | 21.6 | | | | |
| | | | | | | | | |
| 1501 | Miller | 47.1 | 22.1 | 14.9 | | | | |
| 1502 | O'Brian | 25.3 | 30.8 | 13.9 | | | | |
| 1503 | Pattee-Hayes | 45.4 | 17.3 | 6.9 | | | | |
| | | | | | | | | |
| | Bitterroot River | 2864.2 | 34.6 | 2057.0 | 27269 | 1.3 | 139807 | 7.6 |

*All drainages, on this page, were unburned.

Table B-2: Estimated 25-year pre-fire instantaneous peak runoff and percent increase in peak flow estimated to occur as result of the 2000 fires for streams in each hydrologic unit in the Bitterroot River drainage.

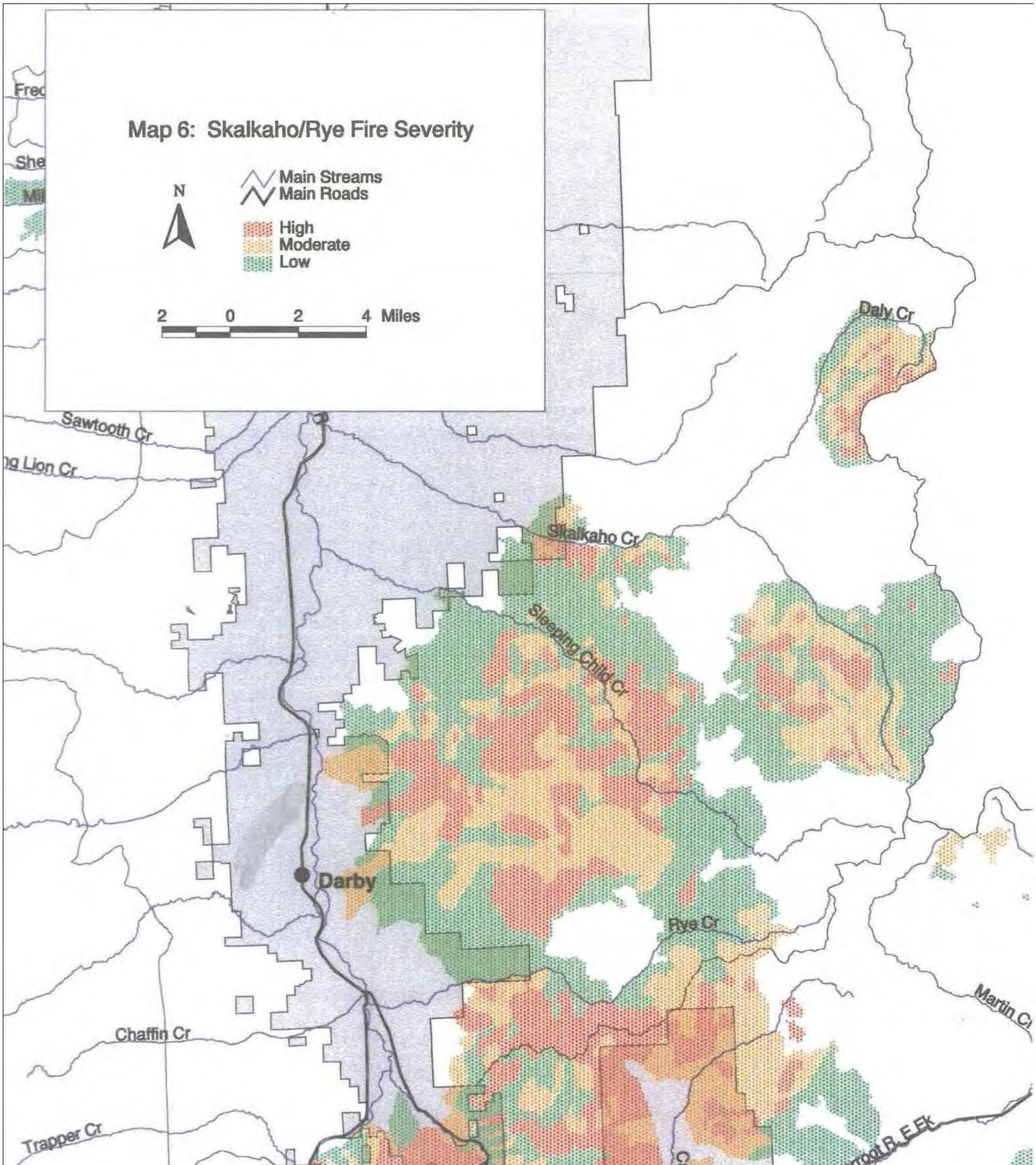
| Sixth Code HUC | Name of Stream | Instantaneous 25-year peak Flow, cfs | Percent Increase From 2000 Fires |
|---|---|---|---|
| 0101 | West Fork Bitterroot above Deer Creek | 1250 | |
| 0102 | Deer Creek at mouth | 600 | 0.2 |
| 0103 | Hughes Creek at mouth | 1190 | 1.6 |
| 0104 | Overwhich Creek at mouth | 920 | 6.4 |
| 0105 | Blue Joint Creek near mouth | 1170 | 2.7 |
| 0106 | Slate Creek near mouth | 430 | 12.8 |
| 0107 | West Fork Bitterroot below Little Boulder Creek | 3800 | 3.4 |
| | | | |
| 0201 | Sheephead Creek at mouth | 580 | |
| 0202 | Watchtower Creek at mouth | 610 | |
| 0203 | Little West Fork Creek at mouth | 870 | |
| 0204 | Nez Perce Creek at mouth | 820 | |
| | | | |
| 0301 | West Fork Bitterroot above Nez Perce Creek | 500 | 0.3 |
| 0302 | Boulder Creek at mouth | 1040 | |
| 0303 | Piquett Creek at mouth | 610 | 2.2 |
| 0304 | Trapper Creek at mouth | 970 | |
| 0305 | West Fork Bitterroot above East Fork | 7470 | 1.7 |
| | | | |
| 0401 | Moose Creek at mouth | 560 | 0.9 |
| 0402 | East Fork Bitterroot above Moose Creek | 1100 | 12.3 |
| 0403 | Martin Creek at mouth | 660 | 0.8 |
| 0404 | Meadow Creek at mouth | 670 | 18.9 |
| 0405 | East Fork Bitterroot below Bertie Lord Creek | 2290 | 8.6 |
| | | | |
| 0501 | Tolan Creek at mouth | 430 | 10.0 |
| 0502 | Camp Creek at mouth | 640 | 10.0 |
| 0503 | East Fork Bitterroot below Camp Creek | 3130 | 8.8 |
| 0504 | Cameron Creek at mouth | 650 | 20.0 |
| 0505 | Warm Springs Creek at mouth | 780 | 4.5 |
| 0506 | East Fork Bitterroot above West Fork Bitterroot | 3940 | 9.4 |
| | | | |
| 0601 | Lost Horse Creek above South Fork | 1540 | |
| 0602 | Lost Horse Creek at mouth | 2150 | |
| | | | |

Table B-2, Continued

| Sixth Code HUC | Name of Stream | Instantaneous 25-year peak Flow, cfs | Percent Increase From 2000 Fires |
|---|---|---|---|
| 0701 | Sleeping Child Creek above Divide Creek | 380 | 3.8 |
| 0702 | Divide Creek at mouth | 420 | 7.1 |
| 0703 | Sleeping Child Creek below Two Bear Creek | 960 | 7.8 |
| 0704 | Little Sleeping Child Creek at mouth | 250 | 13.9 |
| 0705 | Sleeping Child Creek at mouth | 1290 | 8.0 |
| | | | |
| 0801 | Rye Creek at mouth | 780 | 15.9 |
| 0802 | Chaffin Creek at mouth | 640 | |
| 0803 | Tin Cup Creek at mouth | 1590 | |
| 0804 | Rock Creek inflow Lake Como | 1850 | |
| 0805 | Bitterroot River below Chaffin Creek | 11440 | 4.6 |
| 0806 | Bitterroot River below Skalkaho Creek | 17170 | 3.3 |
| | | | |
| | | | |
| 0901 | Skalkaho Creek above Daly Creek | 820 | 7.4 |
| 0902 | Daly Creek at mouth | 750 | 4.6 |
| 0903 | Skalkaho Creek below Daly Creek | 1010 | 6.0 |
| 0904 | Skalkaho Creek at mouth | 1470 | 5.5 |
| | | | |
| 1001 | Gird Creek below Saint Clair Creek | 540 | |
| 1002 | Roaring Lion Creek at mouth | 890 | |
| 1003 | Sawtooth Creek at mouth | 780 | |
| 1004 | Canyon Creek at mouth | 520 | 1.0 |
| 1005 | Blodgett Creek at mouth | 930 | 0.6 |
| 1006 | Willow Creek near mouth | 320 | |
| 1007 | Bitterroot River below Gird Creek | 19200 | 3.0 |
| | | | |
| 1101 | Mill Creek at mouth | 1410 | 1.3 |
| 1102 | Bear Creek at mouth | 1240 | |
| 1103 | Sweathouse Creek at mouth | 660 | |
| 1104 | Bitterroot River below Sweathouse Creek | 21460 | 2.7 |
| 1105 | Bitterroot River below Willoughby Creek | 21770 | 2.7 |
| | | | |

Table B-2, Continued.

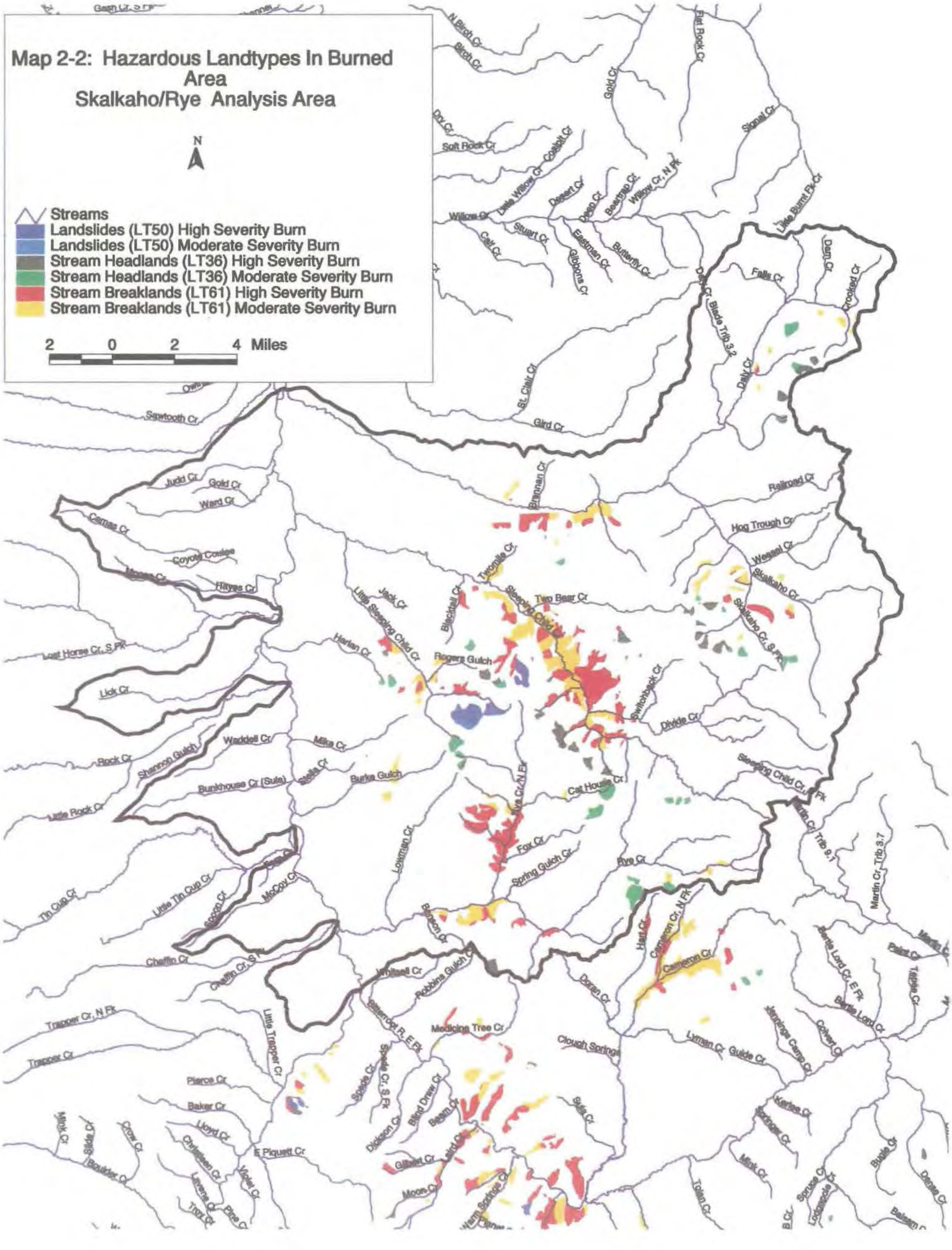
| Sixth Code HUC | Name of Stream | Instantaneous 25-year peak Flow, cfs | Percent Increase From 2000 Fires |
|---|---|---|---|
| 1201 | Big Creek at mouth | 1000 | |
| 1202 | McCalla Creek at mouth | 410 | |
| 1203 | Kootenia Creek above McCalla Creek | 1450 | |
| 1204 | Burnt Fork Bitterroot above Gold Creek | 820 | |
| 1205 | Burnt Fork Bitterroot above Slocum Creek | 760 | |
| 1206 | Bitterroot River below Burnt Fork Bitterroot | 23820 | 2.4 |
| | | | |
| 1301 | Bass Creek at mouth | 530 | |
| 1302 | Ambrose Creek at mouth | 270 | |
| 1303 | Threemile Creek at mouth | 670 | |
| 1304 | Sweeney Creek at mouth | 670 | |
| 1305 | Bitterroot River below Eightmile Creek | 25300 | 2.3 |
| 1306 | Eightmile Creek at mouth | 160 | |
| 1307 | One Horse Creek at mouth | 470 | |
| 1308 | Carlton Creek at mouth | 230 | |
| 1309 | Bitterroot River above Lolo Creek | 25980 | 2.2 |
| | | | |
| 1401 | West Fork Lolo Creek above East Fork | 350 | |
| 1402 | East Fork Lolo Creek above West Fork | 600 | |
| 1403 | Granite Creek at mouth | 500 | |
| 1404 | Howard Creek at mouth | 320 | |
| 1405 | Lolo Creek Above Howard Creek | 1200 | |
| 1406 | Butte Creek at mouth | 350 | |
| 1407 | South Fork Lolo Creek at mouth | 780 | |
| 1408 | Lolo Creek below South Fork Lolo Creek | 2220 | |
| 1409 | Lolo Creek at mouth | 2470 | |
| | | | |
| 1501 | Miller Creek at mouth | 560 | |
| 1502 | O'Brien Creek at mouth | 490 | |
| 1503 | Bitterroot River at Missoula (mouth) | 30650 | 2.0 |
| | | | |


Map 6: Skalkaho/Rye Fire Severity
N
Main Streams
Main Roads
High
Moderate
Low
2
0
2
4 Miles
Sawtooth Cr
Daly Cr
Skalkaho Cr
Sleeping Child Cr
Darby
Rye Cr
Martin Cr
Chaffin Cr
Trapper Cr
Cameron Cr
Bitterroot R. E Fk
Boulder Cr

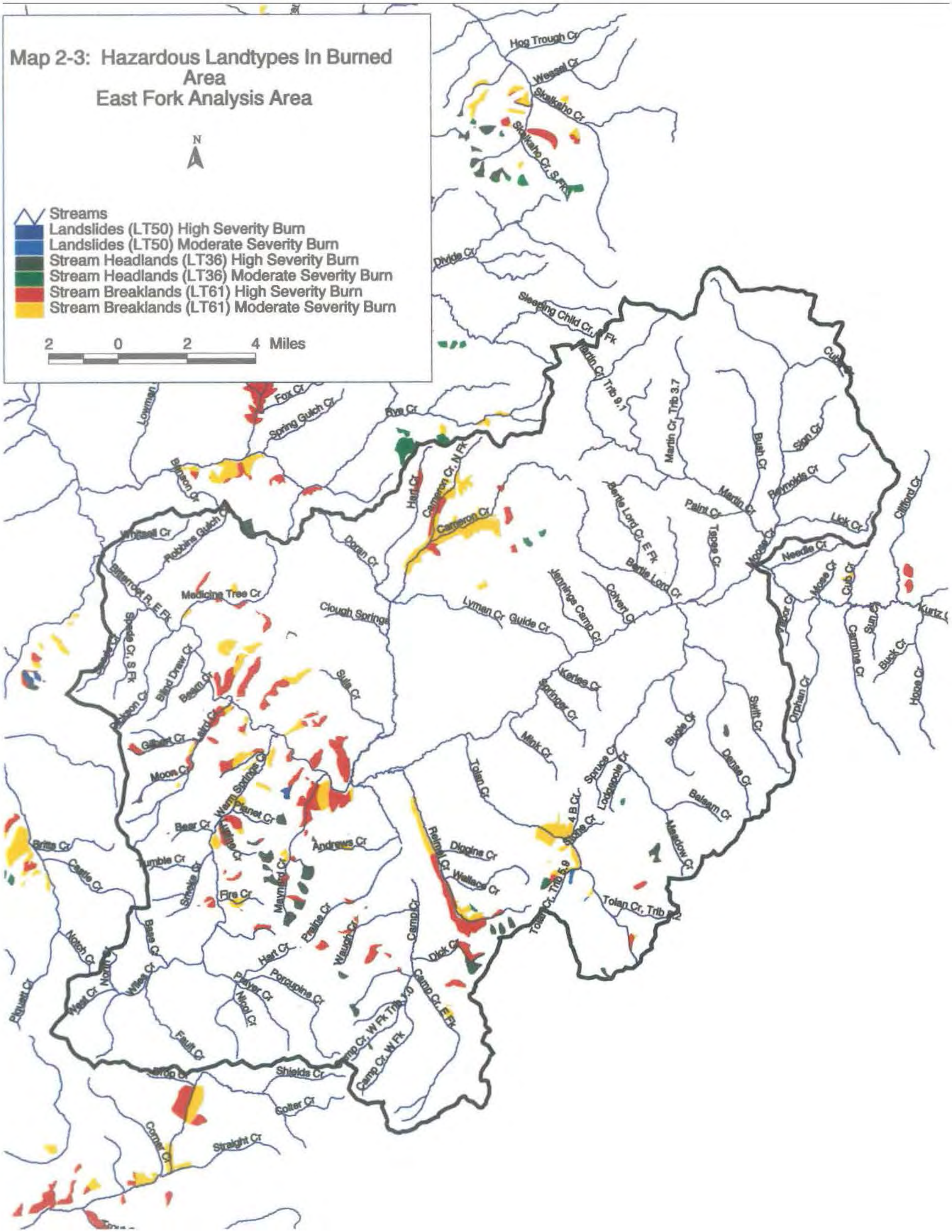
# Appendix C. Photos

**Figure 2-1.** Log terraces were constructed on many parts of the forest to reduce erosion from water repellent slopes.

Map 2-1: Hazardous Landtypes In Burned Areas
Bitterroot National Forest



Map 2-2: Hazardous Landtypes In Burned Area
Skalkaho/Rye Analysis Area
N
Streams
Landslides (LT50) High Severity Burn
Landslides (LT50) Moderate Severity Burn
Stream Headlands (LT36) High Severity Burn
Stream Headlands (LT36) Moderate Severity Burn
Stream Breaklands (LT61) High Severity Burn
Stream Breaklands (LT61) Moderate Severity Burn
2 0 2 4 Miles


Map 2-3: Hazardous Landtypes In Burned Area
East Fork Analysis Area
N
Streams
Landslides (LT50) High Severity Burn
Landslides (LT50) Moderate Severity Burn
Stream Headlands (LT36) High Severity Burn
Stream Headlands (LT36) Moderate Severity Burn
Stream Breaklands (LT61) High Severity Burn
Stream Breaklands (LT61) Moderate Severity Burn
2 0 2 4 Miles
Hog Trough Cr
Divide Cr
Sleeping Child Cr
Martin Cr
Rye Cr
Cameron Cr
Doran Cr
Medicine Tree Cr
Clough Springs
Lyman Cr
Guide Cr
Jennings Camp Cr
Bertie Lord Cr
Moose Cr
Needle Cr
Clifford Cr
Kurtz C
Orphan Cr
Hope Cr
Buck Cr
Swift Cr
Bugle Cr
Dense Cr
Balsam Cr
Meadow Cr
Tolan Cr
Diggins Cr
Wallace Cr
Camp Cr
Andrews Cr
Planet Cr
Warm Springs Cr
Bear Cr
Tumble Cr
Fire Cr
Porcupine Cr
Nicol Cr
Fault Cr
Shields Cr
Colter Cr
Straight Cr
Corner Cr
Britts Cr
Castle Cr
Notch Cr
Piquett Cr
West Cr
Gilbert Cr
Moon Cr
Laird Cr
Beam Cr
Blind Draw Cr
Robbins Gulch Cr
Whitsell Cr
Spring Gulch Cr
Fox Cr
Lowman Cr

# 4.3 Fisheries

## 4.3.1 Background

### *4.3.1.1 Introduction to Bitterroot Fisheries*

The fires of 2000 burned large portions of the Bitterroot, Selway, and Salmon River basins. The Bitterroot River is a major tributary of the Clark Fork River. The Selway River and Salmon River are major tributaries of the Clearwater River and Snake River, respectively.

The **Bitterroot River basin** is home to three native salmonid species: bull trout, *Salvelinus confluentus*; westslope cutthroat trout, *Oncorhynchus clarki lewisi*; and mountain whitefish, *Prosopium williamsoni*. All of the fish species in the Bitterroot River basin are non-anadromous, which means that they spend their entire lives in fresh water and do not migrate to the ocean.

The **Selway and Salmon River basins** are home to a diverse anadromous (fish that spend their adult lives in the ocean) and inland fishery. Native anadromous salmonids include chinook salmon, *Oncorhynchus tschawytscha*; and steelhead, *Oncorhynchus mykiss*. Native inland salmonids include bull trout, westslope cutthroat trout, and mountain whitefish.

The Bitterroot National Forest currently supports two sensitive and two threatened fish species:

- Westslope cutthroat trout = Sensitive
- Selway River spring/summer chinook salmon = Sensitive
- Snake River spring/summer chinook salmon = Threatened
- Bull trout = Threatened
- Steelhead = Threatened

Almost all of the fires in the Bitterroot National Forest part of the Selway and Salmon River basins occurred on wilderness lands. All of the Idaho drainages are similar in that they contain pristine spawning and rearing habitat for chinook salmon, steelhead, bull trout, and westslope cutthroat trout, and all of their hydrologic connections are intact. Fish are free to move throughout the stream system year-round. Habitat fragmentation and fish population isolation has not occurred on the Idaho portion of the forest as it has in the Bitterroot River basin.

Most of the fires in the Bitterroot River basin occurred on non-wilderness lands. The fires of 2000 burned large portions of the following tributaries to the Bitteroot River: the East Fork of the Bitterroot River, the West Fork of the Bitterroot River, Rye Creek, Sleeping Child Creek, Skalkaho Creek, Canyon Creek, Blodgett Creek, Mill Creek, and Sheafman Creek.

Although these burned drainages differ in their geologies, land types, and locations on the forest, they all contain similar fish communities and habitat requirements. From the fisheries recovery perspective, two important features distinguish these burned drainages: (1) the life history structure of the fish community – do the burned drainages contain both resident and migratory forms of bull trout and westslope cutthroat trout?, and (2) connectivity – do the burned drainages still maintain a fish-passable, year-round connection to the Bitterroot River?

The **East Fork of the Bitterroot** is the only burned drainage that definitely possesses both of these features. Resident and migratory bull trout and westslope cutthroat trout populations are present in this drainage, and all of the larger streams in the drainage are connected to each other, the East Fork, and the main stem of the Bitterroot River throughout the year.

The **West Fork of the Bitterroot** drainage contains resident and migratory bull trout and westslope cutthroat trout populations, but the populations in the upper half of the drainage are permanently isolated from the rest of the Bitterroot River basin by the impassible fish barrier at Painted Rocks Dam.

Skalkaho Creek, Sleeping Child Creek, and Rye Creek are all large, eastside tributaries to the Bitterroot River. None of these streams maintains its historic, year-round connection to the Bitterroot River.

The **Skalkaho Creek** drainage contains some of the best resident bull trout and westslope cutthroat trout populations on the forest, but migratory fish are absent. Fish from the Bitterroot River can only access the lower two miles of Skalkaho Creek before encountering at least four impassible irrigation barriers.

**Sleeping Child Creek** still maintains a marginal, year-round connection to the Bitterroot River (Nelson, 1999: 48-49). This makes it unique because very few of the east or west side tributaries to the Bitterroot River still have a fish-passable connection to the river. There is a concrete diversion on private land near the Bitterroot River, but fish-trapping data indicates that at least some migratory bull trout and westslope cutthroat trout can pass back and forth over this structure (Nelson, 1999: 41-45, 48-49). A few migratory bull trout and westslope cutthroat trout from the Bitterroot River probably still spawn in the Sleeping Child Creek drainage. Good resident bull trout and westslope cutthroat trout populations are present in the Sleeping Child drainage.

**Rye Creek** maintains a seasonal connection to the Bitterroot River from mid-September through mid-July. Montana Department of Fish, Wildlife, and Parks (MFWP) radio telemetry data indicates that at least a few migratory westslope cutthroat trout move into the Rye Creek drainage to spawn during early summer peak flows (USDA Forest Service, 1999: 97-98). During the summer irrigation season, the lower two miles of Rye Creek are dewatered and sometimes completely dried up for several weeks. There is still a small resident bull trout population in upper Rye Creek, but migratory bull trout

have not been found in the Rye Creek drainage and are believed to be absent. Resident westslope cutthroat trout are common throughout most of the Rye Creek drainage.

Portions of four west-side canyon tributaries to the Bitterroot River burned in summer, 2000: Canyon Creek, Blodgett Creek, Mill Creek, and Sheafman Creek. None of these streams maintains a year-round connection to the Bitterroot River. A poor, seasonal connection may occur for a few months during high water, but for the majority of the year, dewatering and numerous irrigation barriers on private land block fish movement between the forest and the Bitterroot River. Migratory bull trout and westslope cutthroat trout are believed to be absent in these four drainages. Resident westslope cutthroat trout are common in all four drainages on National Forest land. Resident bull trout are uncommon in Blodgett Creek and Mill Creek, and absent in Canyon Creek and Sheafman Creek.

### *4.3.1.2 Regional Context*

The Bitterroot River basin is classified as a Category 2 watershed in the Upper Columbia River Basin Draft Environmental Impact Statement (USDA Forest Service and USDI Bureau of Land Management, 1997a: 158-159). The Category 2 classification means that the basin supports important aquatic resources and some scattered strongholds for native fish exist, but there has also been increased fragmentation of native fish populations resulting from habitat disruption or loss. Category 2 watersheds contain numerous drainages where native species have been lost or are at risk.

The current status of nearly all of the bull trout and westslope cutthroat trout populations in the Bitterroot River basin is rated as "present, but depressed" (USDA Forest Service and USDI Bureau of Land Management, 1997b: 1181, 1197). A major reason for the "present, but depressed" rating is the lack of migratory fish in the populations. Other reasons include habitat fragmentation, loss of genetic diversity (especially pertaining to westslope cutthroat trout), and the widespread presence of non-native trout species capable of displacing bull trout and westslope cutthroat trout. A few bull trout and westslope cutthroat trout populations in the upper East Fork drainage are rated as "present and strong", primarily because they still contain migratory fish.

The recommendations for Category 2 watersheds focus on restoring the connections between fragmented fish populations and protecting the native fish strongholds that still exist. More intensive forest management should be conducted in areas that are not stronghold watersheds, and periods of intensive forest management should be followed by active watershed restoration (e.g., road removal) and long periods of recovery (USDA Forest Service and USDI Bureau of Land Management, 1997a: 158).

The Selway River and Salmon River basins are classified as Category 1 watersheds in the Upper Columbia River Basin Draft Environmental Impact Statement (USDA Forest Service and USDI Bureau of Land Management, 1997a: 157-159). Category 1 watersheds closely resemble natural, fully functional aquatic ecosystems. They support large,

contiguous blocks of high quality habitat and watersheds with strong populations of multiple species. Connectivity is unimpeded among watersheds. All life histories of native fish, including migratory forms, are present and important. Category 1 watersheds are resilient to large-scale disturbances such as wildfire because they contain large blocks of high quality habitat that is connected by the movement of migratory fish (USDA Forest Service and USDI Bureau of Land Management, 1997a: 157).

The current status of nearly all of the bull trout and westslope cutthroat trout populations in the Bitterroot National Forest portions of the Selway River and Salmon River basins is rated as "present and strong" (USDA Forest Service and USDI Bureau of Land Management, 1997b: 1181, 1197). The current status of the chinook salmon and steelhead populations in the Bitterroot National Forest portions of the Selway River and Salmon River basins is rated as "present, but depressed" (USDA Forest Service and USDI Bureau of Land Management, 1997b: 1217, 1230). The main reason for the "present, but depressed' rating is the low numbers of adult fish that return from the ocean to spawn.

The Upper Columbia River Basin Draft Environmental Impact Statement recommends that land management activities in Category I watersheds be highly conservative in order to minimize risks to the aquatic ecosystem (USDA Forest Service and USDI Bureau of Land Management, 1997a: 157).

## 4.3.2 Issues

The key fisheries questions that should be answered by this assessment are:

- What were the short-term effects of the fires on the forest's native fish populations?
- Were any bull trout or westslope cutthroat trout populations lost as a result of the fires?
- Where fish kills occurred, can full recovery be expected, and how long will that take?
- How has fish habitat changed, and how is it likely to change over time as the forest regenerates?
- How will the fires affect key spawning areas for native fish?
- Are the effects of the fires on the fishery within historic ranges?
- Are past management actions likely to combine with the fires to have an adverse cumulative effect on native fish populations and habitat?
- Is rehabilitation needed, and if so, where should it be focused and what are the priorities?
- What about amphibians and aquatic insects?
- What about the fishery in the unburned urban interface?

## 4.3.3 Historic and Pre-fire Conditions

In May 2000, Bitterroot National Forest fisheries biologists completed two comprehensive reports that describe the pre-fire condition of fish habitat and populations in the Bitterroot River basin and the upper Selway River basin. These reports are titled the "Bitterroot River Section 7 Watershed Baseline" (USDA Forest Service, 2000a) and the "Upper Selway River Biological Assessment" (USDA Forest Service, 2000b). For information on the pre-fire condition of fish habitat and populations in the Bitterroot River and Selway River basins, the reader should consult these two reports. Copies of these reports are available upon request from the Sula Ranger Station. The information in these two reports is included by reference and will not be reiterated in this fire assessment.

In the "reference condition", the larger streams in the Bitterroot River basin would contain healthy populations of bull trout and westslope cutthroat trout, with all life history forms (resident and migratory) and life stages abundantly represented in the population. In the Selway and Salmon River basins, in addition to healthy bull trout and westslope cutthroat trout populations, chinook salmon and steelhead juveniles and adults would be present in good numbers. Because all of the stream connections would be intact, fish could move freely throughout the basin except where blocked by natural barriers.

A reference stream in all three basins would contain most, if not all, of the following fish habitat components: (1) a high frequency of deep pools with complex hiding cover; (2) abundant quantities of large woody debris; (3) a stable stream channel with well-developed stream bank vegetation; (4) a high percentage of undercut banks (in the smaller streams); (5) clean cobble and boulder substrate; (6) well-distributed beds of clean spawning gravels; (7) a cold, stable water temperature regime; (8) a high percentage of riparian canopy cover (in the smaller streams); (9) natural sediment yields in equilibrium with the stream's sediment transport capacity; and (10) a well-vegetated floodplain capable of buffering periodic flooding. Depending on channel type and gradient, not all of these habitat components would be available in every reach in the watershed. However, on the watershed scale, all of these habitat features would be abundantly distributed.

In a reference stream, fires and floods would cause the largest disturbances to the aquatic ecosystem. These two natural processes would trigger pulsed inputs of large woody debris and gravel substrates necessary for the formation of pools and spawning beds, with long periods of recovery following the disturbance. Fire's impact on streams would vary across the watershed depending on elevation and aspect. In most areas, fires would create a mosaic of successional stages in riparian zones, burning some areas in a stand-replacing, high severity manner, while completely missing other nearby areas. Following a fire, large quantities of woody debris would be recruited to the stream for several decades. This recruitment could occur slowly through blowdown of individual

snags, or quickly in landslides from intensely burned tributaries. The woody debris recruited from a fire would move slowly downstream over time, trapping bedload and creating important pool habitats and gravel spawning beds along the way. Because fires and floods are highly variable in time and space, at any one point in time, most of the streams in a reference watershed would be in various stages of recovery from their last disturbance. On the river basin scale, this variability would maintain the stability and health of the aquatic ecosystem.

The fishery on the Bitterroot National Forest is generally below its natural potential. One of the major reasons is the loss of year-round connectivity to the Bitterroot River. Other important reasons include habitat fragmentation, dewatering, angling, fish barriers, the loss of the migratory fish, the decline of salmon and steelhead runs, and the displacement of native trout by non-native trout. Because of the decline of the salmon and steelhead runs in Idaho, and many decades of fire suppression across the forest, there are really no "true" reference streams left on the Bitterroot National Forest. The areas that most closely resemble reference conditions are:

- the entire Idaho portion of the forest;
- the upper East Fork drainage above the East Fork Trailhead;
- the unroaded portions of the West Fork drainage above Painted Rocks Dam;
- the unroaded portions of the Warm Springs Creek drainage; and,
- the unroaded portions of the Nez Perce Fork drainage.

Some streams no longer maintain an intact connection to the Bitterroot River, but do contain fish habitat that is near reference condition on the forest. These areas include:

- the unroaded portions of the westside canyon streams;
- the headwaters of the Skalkaho Creek drainage;
- the headwaters of the Sleeping Child Creek drainage; and,
- the headwaters of the Burnt Fork drainage.

## 4.3.4 Effects and Implications of the Fires of 2000

### *4.3.4.1 Fish-bearing Drainages Burned in 2000*

The fires of 2000 burned portions of 126 named, fish-bearing streams on the Bitterroot National Forest (see Appendix A). At least several dozen small, unnamed, fish-bearing tributaries to these named streams also experienced some level of fire. Most of the unnamed tributaries are located in the Rye Creek, Sleeping Child Creek, and Skalkaho Creek drainages.

Table 3-1 lists all of the major forest drainages that had at least some fish-bearing streams burned during 2000. The other variables in Table 3-1 include:

- The stream that the burned drainage is tributary to
- The presence/absence of migratory and resident forms of bull trout, westslope cutthroat trout (WSCT), chinook salmon, and steelhead
- Connectivity = are the fish populations in the drainage connected, impaired, or isolated? "Connected" means that fish can enter or leave the drainage at any time of the year. "Impaired" means that fish can probably enter or leave the drainage during the high water periods of the year, but not at low flows. "Isolated" means that fish cannot enter or leave the drainage.
- The percent of fish bearing stream miles in the drainage that were burned with moderate and high severity fire.

***Table 3-1. Fish-bearing drainages burned on the Bitterroot National Forest during the fires of 2000***

| Drainage | Tributary to... | Connected, Impaired, or Isolated? | Migratory WSCT? | Resident WSCT? | Migratory bull trout? | Resident bull trout? | Chinook salmon? | Steelhead? | % of stream miles burned moderate and high |
|---|---|---|---|---|---|---|---|---|---|
| East Fork (below Martin Creek) | Bitterroot River | Connected | X | X | X | X | | | 20 |
| East Fork (above Martin Creek) | Bitterroot River | Connected | X | X | X | X | | | 34 |
| Medicine Tree Creek | East Fork | Impaired | | X | | | | | 40 |
| Laird Creek | East Fork | Connected | X | X | X | X | | | 50 |
| Warm Springs Creek | East Fork | Connected | X | X | X | X | | | 10 |
| Maynard Creek | East Fork | Connected | | X | | | | | 60 |
| Camp Creek | East Fork | Impaired | X | X | | X | | | 20 |
| Cameron Creek | East Fork | Connected | X | X | | | | | 48 |
| Reimel Creek | East Fork | Isolated | | X | | | | | 63 |
| Tolan Creek | East Fork | Impaired | X | X | | X | | | 43 |
| Guide Creek | East Fork | Isolated | | X | | | | | 0 |
| Jennings Camp Creek | East Fork | Impaired | | X | | | | | 0 |
| Meadow Creek | East Fork | Connected | X | X | X | X | | | 44 |
| Martin Creek | East Fork | Connected | X | X | X | X | | | 0 |
| Moose Creek | East Fork | Connected | X | X | X | X | | | 0 |
| West Fork Bitterroot River | Bitterroot River | Connected | X | X | X | X | | | 0 |
| Piquett Creek | Lower West Fork | Connected | X | X | | X | | | 3 |
| Blue Joint Creek | Upper West Fork | Connected | X | X | X | X | | | 14 |
| Slate Creek | Upper West Fork | Connected | X | X | X | X | | | 25 |
| Overwhich Creek | Upper West Fork | Connected | X | X | X | X | | | 13 |
| Coal Creek | Upper West Fork | Connected | | X | | | | | 0 |
| West Creek | Upper West Fork | Connected | | X | | | | | 39 |
| Hughes Creek | Upper West Fork | Connected | X | X | X | X | | | 3 |
| Chicken Creek | Upper West Fork | Impaired | | X | | X | | | 31 |
| Rye Creek | Bitterroot River | Impaired | X | X | | X | | | 21 |
| North Rye Creek | Rye Creek | Impaired | | X | | | | | 33 |
| Sleeping Child Creek | Bitterroot River | Impaired | X | X | X | X | | | 25 |
| Little Sleeping Child Creek | Sleeping Child | Isolated | | X | | | | | 29 |
| Skalkaho Creek | Bitterroot River | Isolated | | X | | X | | | 12 |
| Daly Creek | Skalkaho Creek | Isolated | | X | | X | | | 1 |
| Canyon Creek | Bitterroot River | Impaired | | X | | | | | 0 |
| Blodgett Creek | Bitterroot River | Isolated | | X | | X | | | 2 |
| Mill Creek | Bitterroot River | Isolated | | X | | X | | | 0 |
| Sheafman/Cow Creeks | Bitterroot River | Isolated | | X | | | | | 11 |
| Selway River | Clearwater River | Connected | X | X | X | X | X | X | 0 |
| Sheep Creek | Selway River | Connected | X | X | X | X | | | 1 |
| Indian Creek | Selway River | Connected | X | X | X | X | X | X | 0 |
| Little Clearwater River | Selway River | Connected | X | X | X | X | X | X | 12 |
| Magruder Creek | Selway River | Connected | X | X | X | X | | | 0 |
| Kim Creek | Selway River | Connected | N | N | N | N | N | N | 11 |
| Gold Pan Creek | Selway River | Connected | N | N | N | N | N | N | 0 |
| Three Lakes Creek | Selway River | Connected | N | N | N | N | N | N | 8 |
| Goat Creek | Selway River | Connected | N | N | N | N | N | N | 8 |
| Witter Creek | Selway River | Connected | N | N | N | N | N | N | 0 |
| Swet Creek | Selway River | Connected | X | X | X | X | | | 0 |
| Thirteen Creek | Selway River | Connected | N | N | N | N | N | N | 0 |
| Cedar Creek | Whitecap Creek | Connected | X | X | X | X | | | 0 |
| Lookout Creek | Whitecap Creek | Connected | X | X | X | X | | | 0 |
| Salmon River | Snake River | Connected | X | X | X | X | X | X | 0 |
| Elkhorn Creek | Salmon River | Connected | N | N | N | N | N | N | 0 |
| Fortune Creek | Salmon River | Connected | N | N | N | N | N | N | 0 |
| Big Squaw Creek | Salmon River | Connected | X | X | X | X | | X | 0 |
| Harrington Creek | Salmon River | Connected | X | X | X | X | | X | 0 |
| Black Creek | Salmon River | Connected | N | N | N | N | N | N | 0 |
| Sabe Creek | Salmon River | Connected | X | X | X | X | | X | 5 |
| Hamilton Creek | Sabe Creek | Connected | X | X | X | X | | X | 5 |

The trout species presence/absence data in Table 3-1 is pre-fire data obtained from the Bitterroot fisheries presence/absence database. A copy of this database is available upon request from the Sula Ranger District. Maps 3-1 and 3-2 in Appendix C display the distribution of bull trout and westslope cutthroat trout in the Bitterroot River basin relative to burn severity. The salmon and steelhead presence/absence data is based on Bitterroot National Forest and Idaho Fish and Game snorkel surveys. Some of the streams in Table 3-1 have not been surveyed. For those streams, the species present/absent columns are marked with "N" for no data. A reasonable assumption is that the un-surveyed streams probably contain a similar fish assemblage as the streams they flow into.

Fourteen drainages had at least 25% of their fish-bearing stream miles burned by moderate and high severity fire. They are ranked from highest to lowest in the following list. The numbers in the "Percent burned" column is the percent of fish-bearing stream miles that were burned in the drainage, not the percent of the drainage area that was burned. Table 2.1 in Section 4.2 lists the percent of the drainage area that was burned.

| Drainage | Percent burned | Miles burned | Watershed |
|---|---|---|---|
| Reimel Creek | 63 | 5.6 | Lower East Fork |
| Maynard Creek | 60 | 3.4 | Lower East Fork |
| Laird Creek | 50 | 6.4 | Lower East Fork |
| Cameron Creek | 48 | 18.5 | Lower East Fork |
| Meadow Creek | 44 | 12.9 | Upper East Fork |
| Tolan Creek | 43 | 6.9 | Lower East Fork |
| Medicine Tree Creek | 40 | 2.0 | Lower East Fork |
| West Creek | 39 | 3.0 | Upper West Fork |
| Upper East Fork | 34 | 18.9 | Upper East Fork |
| North Rye Creek | 33 | 4.7 | Rye Creek |
| Chicken Creek | 31 | 2.4 | Upper West Fork |
| Little Sleeping Child | 29 | 3.1 | Sleeping Child Creek |
| Sleeping Child Creek | 25 | 15.1 | Sleeping Child Creek |
| Slate Creek | 25 | 3.8 | Upper West Fork |

On a percentage basis, the fish-bearing tributaries to the lower East Fork had the greatest proportion of their stream miles burned by moderate and high severity fire. As far as stream mileage is concerned, the upper East Fork (including Meadow Creek) had the most fish-bearing stream miles burned by moderate and high severity fire, followed by the Cameron Creek and Sleeping Child Creek drainages. The greatest extent of low severity fire on the Forest occurred in the Selway River and Salmon River basins.

### *4.3.4.2 Short-term Effects on the Bitterroot's Native Fish Populations*

Montana Department of Fish, Wildlife and Parks (MFWP) and Bitterroot National Forest fisheries personnel electrofished several of the burned streams within a month following

the fire **(Figure 3-1, Appendix B).** Burned streams that were electrofished and the severity of the burn in the sections of the streams that were monitored are:

| | |
|---|---|
| Rye Creek | Moderate severity |
| North Rye Creek | High severity |
| Sleeping Child Creek | Moderate severity |
| Skalkaho Creek | Unburned, but burned areas upstream of section |
| Warm Springs Creek | Low severity |
| Lower Laird Creek | High severity |
| Upper Laird Creek | Low severity |
| Lower Reimel Creek | Moderate severity |
| Upper Reimel Creek | Moderate severity |
| Meadow Creek | Unburned, but burned areas upstream of section |
| Lower East Fork | Low severity |
| Middle East Fork | Moderate severity |
| Upper East Fork | Unburned, but burned areas upstream of section |
| Chicken Creek | High severity |
| Little Blue Joint Creek | High severity |

Within two weeks of the fires, Bitterroot National Forest fisheries personnel walked several miles along some of the burned streams looking for both live and dead fish **(Figure 3-2, Appendix B).** The burned streams and the burn severity of their walk-through sections include:

| | |
|---|---|
| Laird Creek | Mix of moderate and high severity |
| Gilbert Creek | High severity |
| Andrews Creek | High severity |
| Praine Creek | High severity |
| Waugh Creek | Low severity |
| Reimel Creek | Mix of moderate and high severity |
| Lyman Creek | High severity |
| Blue Joint Creek | Mix of low and moderate severity |
| Little Blue Joint Creek | High severity |

From this electrofishing and walk-through data, some general trends are evident concerning the fires' short-term effects on fish populations.

In the high severity areas, heavy losses of three native species (westslope cutthroat trout; bull trout; and slimy sculpin) probably occurred. Electrofishing results indicate that losses ranged from at least 50% of the pre-fire numbers to as high as 95% of the pre-fire numbers. None of the native species appears to have been immune from the fires. We found dead westslope cutthroat trout, bull trout, and slimy sculpin in relative proportion to what was present prior to the fires. Fish kills occurred in both reference and managed streams, and the main factor was the severity of the burn. It did not appear to matter if the stream were managed or roadless prior to the fire. Fish kills

following high severity fires have been commonly reported in the literature in both managed and reference streams (Minshall et al., 1990; McMahon and deCalesta, 1990; Minshall and Brock, 1991; Rieman et al., 1997).
The exact cause of the fish kills is unknown and has not been well established in the literature (Gresswell, 1999). Possible causes of death include lethal water temperatures (Hall and Lantz, 1969; Spencer and Hauer, 1991), chemical toxicity from smoke or ash (Cushing et al., 1963; Minshall et al., 1990; Woodward, 1989), large increases in ammonium and phosphorus (Spencer and Hauer, 1991), or a combination of all of these factors. At the time of the August 6th firestorm, water temperatures were being recorded in Laird Creek every 2 hours and 24 minutes with a HOBO-TEMP thermograph (unpublished MFWP water temperature monitoring data, 2000). This thermograph was located in the heart of a high severity burn area that experienced high fish kills and should have recorded some unusually high water temperatures if that was the cause of death. The thermograph did not, however, record any unusually high water temperatures, which means that either stream heating did not occur and something else killed the fish, or heating occurred very quickly and temperatures returned to normal in less than 2 hours and 24 minutes. Laird Creek is a 3rd order stream. During the 1988 Yellowstone fires, fish kills occurred in 3rd order streams similar in size to Laird Creek. However, Minshall and Brock (1991) doubted that temperatures in Yellowstone's 3rd order streams reached levels lethal to fish. Research by Cushing et al., (1963) also supports the belief that water temperatures in larger streams are usually not lethal to fish during fires. The walk-through carcass surveys indicate that it does not take a large area of high intensity burn to cause fish kills. In Little Blue Joint Creek, dead trout were found in the high severity burn area within 0.25 miles downstream of the green, unburned forest.

In the low and moderate severity areas, no fish carcasses were observed during the walk-through surveys, and the electroshocking surveys showed no significant reductions in native fish populations from the pre-fire data. Fish losses may have occurred in these areas as a result of the fire, but they certainly did not occur on the scale of those observed in the high intensity areas. Based on our data, it is reasonable to assume that the vast majority of the fish survived in the larger streams (3rd order or higher) that were burned with low and moderate severity fire.

During the summer of 2000, MFWP biologists radio-tracked nine adult bull trout spawners (16 to 24 inches in length) in the East Fork drainage. All of these fish spent the month of August in or near burned streams. Four were in the upper East Fork when the Mussigbrod Fire burned the area, two were in Swift Creek, one was in Meadow Creek, one was in Moose Creek, and one was in Warm Springs Creek. Despite the close proximity of fire, no unusual movements were observed, although the fires did restrict the amount of tracking that could occur. The bull trout apparently did not abandon their spawning grounds, even when the fires were very close (unpublished MFWP radio telemetry data, 2000). Fire-related mortality may have occurred in Swift Creek, where two bull trout spawners are presumed dead in an area that was severely burned. The

carcasses and transmitters were not recovered, so the exact cause of death is impossible to pinpoint.

### *4.3.4.3 Effects on Bull Trout and Westslope Cutthroat Trout Populations*

Despite the heavy losses observed in the high severity areas, none of the sampled streams suffered a complete loss of fish. Even the most severely burned streams still contained a few survivors of all the species that were present in the stream before the fires. Based on the electrofishing data, it is reasonable to assume that no bull trout or westslope cutthroat trout populations were lost from any of the larger streams on the forest. Streams in heavily managed watersheds like Laird Creek and Rye Creek, which contained very small bull trout populations prior to the fire, still contained some bull trout in unburned and lightly burned pockets after the fire.

In some of the very small, unnamed tributaries (which were not sampled), complete losses of native trout populations may have occurred where the entire stream channel was "cooked" with a high severity fire. The most likely place where this could have occurred would be in the small, unnamed tributaries to North Rye Creek and Skalkaho Creek. Before the fires, these unnamed tributaries contained very small westslope cutthroat trout populations (less than 500 individuals) restricted to several hundred feet of stream. Rieman et al. (1997) documented the complete extirpation of several bull trout and rainbow trout, *Oncorhynchus mykiss* populations in small, managed streams in the Boise River basin in 1992 following high severity fire. Minshall and Brock (1991) reported dead fish in three small, unmanaged streams in Yellowstone National Park after the 1988 fires, but also observed a few live fish in these same areas. This suggests that mortality from fire is not uniform or that surviving fish migrated into the burned streams soon after the fire (Gresswell, 1999). It also suggests that the main factor determining the magnitude of fish kills is the severity of the fire, not the management condition of the stream prior to the fire.

Even if the fires did not extirpate any bull trout and westslope cutthroat trout populations, there is still a small chance that landslides could destroy some isolated bull trout and westslope cutthroat trout populations over the next couple of years. Although landslides usually do not extirpate all of the fish in a stream, there is at least one notable exception in the literature. Rinne (1996) documented the extirpation of two brook trout, *Salvelinus fontinalis* populations, one rainbow trout population, and one Gila trout, *O. gilae* population from post-fire landslides in Arizona and New Mexico. All of the extirpated trout populations were highly vulnerable to landslides because they were small in number and restricted to very short segments of stream. Novak and White (1990) and Bozek and Young (1994) documented large trout kills following post-fire landslides in Montana and Wyoming, but no populations were completely destroyed. On the Bitterroot National Forest, several large landslides triggered by intense thunderstorms in June and July 1992 killed most of the bull trout and westslope cutthroat trout in the lower five miles of Overwhich Creek, but again, a few fish of both

species survived the event (USDA Forest Service, 1992: 19-23; USDA Forest Service 1993: 65).

### *4.3.4.4 Recovery from Fish Kills*

Full recovery from fish kills should be expected, and is likely to occur within 3 to 5 years in the Idaho portion of the forest, and within 5 to 10 years in the Bitterroot River basin.

Fish are resilient and usually re-colonize burned areas rapidly if they have adequate access (Rieman and Clayton, 1997; Gresswell, 1999). There are numerous examples of this rapid re-colonization in the literature, and several recent examples on the Bitterroot National Forest. Rieman et al. (1997) observed that bull trout and rainbow trout were present in defaunated streams in one year and approached densities of unburned streams 1 to 3 years following a high severity fire. Novak and White (1990) found that rainbow trout densities exceeded pre-fire numbers one year following a fire and flood event. Following the 1988 Canyon Creek Fire, initial fears were that the bull trout and westslope cutthroat trout fishery in the North Fork of the Blackfoot River would be wiped out. These fears proved to be unfounded. Bull trout and westslope cutthroat trout populations recovered well, and brown trout, *Salmo trutta* and rainbow trout numbers boomed 2 to 3 years after the fire (Gadbow, 2000). Post-fire monitoring on the Bitterroot National Forest indicates that bull trout and westslope cutthroat trout populations in Overwhich Creek steadily recovered during the first 2 to 3 years following large landslides (USDA Forest Service, 1994: 74; USDA Forest Service, 1995c: 90), and were back to pre-disturbance levels in 6 to 7 years (unpublished MFWP fish monitoring data, 1998 and 1999). In Storm Creek and Wilkerson Creek **(Figures 3-3, 3-4, Appendix B),** bull trout and westslope cutthroat trout populations have recovered to near pre-fire levels within three years following a 1996 high severity burn (the Swet Fire) (USDA Forest Service, 1999: 99-101). Overwhich Creek, Wilkerson Creek, and Storm Creek are all connected to larger rivers that contain migratory bull trout and westslope cutthroat trout.

The key to rapid recovery is unimpeded fish passage and the presence of migratory fish in the population (Gresswell, 1999). Where these two factors occur, fish populations are resilient to even the most destructive fires. Fish populations that are connected to each other by migratory fish recover faster than those that are isolated and only contain resident fish (Rieman et al., 1997). This is because they have two sources of re-colonization instead of one. Connected fish populations can be quickly restored by migratory fish that move into the area to spawn, or at the same time, by resident fish that survived the fire in unburned patches. Current evidence suggests that even in the case of high severity fires, local extirpation of fishes is patchy, and re-colonization is rapid (Gresswell, 1999). Long-term detrimental effects of fires on fish populations have been limited to areas where fish populations have declined and become isolated by habitat fragmentation (Rinne, 1996; Gresswell, 1999). The key thing to remember is that as long as fish can freely migrate between streams and the aquatic system is in good shape, a rapid recovery is likely to occur (USDA Forest Service, 2000c: 3).

Because of good connectivity and healthy migratory fish populations, all of the fish populations in the burned streams in the Idaho portion of the forest are likely to recover quickly, probably within 3 to 5 years. In the Bitterroot River basin, most of the burned tributaries to the East and West Forks are still connected to their respective rivers and still contain a few migratory bull trout and westslope cutthroat trout. Fish populations in these areas should also recover relatively fast, although probably not as fast as the populations in the Idaho. The fish populations which are likely to recover the slowest will be isolated from a river, lack migratory fish, and have a high degree of severe burn in their watersheds. These could possibly include:

- the isolated resident bull trout populations in portions of Rye Creek and upper Skalkaho Creek; and
- the isolated resident westslope cutthroat trout populations in Little Sleeping Child Creek, North Rye Creek, Medicine Tree Creek, Cow Creek, Reimel Creek; and the tributaries to Camp Creek and Cameron Creek (especially Lyman Creek).

With the exception of Cow Creek, recovery of fish populations is probably not a factor in the Blodgett Fire area because the fish-bearing streams were either unburned or lightly burned. Little to no damage likely occurred to the fish populations in Blodgett Creek, Mill Creek, and Canyon Creek.

### *4.3.4.5 Fish Habitat Changes Caused by the Fires*

Prior to the fires, fish habitat indicators in each of the 6th code hydrologic units in the Bitterroot River basin were rated as "functioning appropriately", "functioning at risk", or "functioning at unacceptable risk" according to rules established by the U.S. Fish and Wildlife Service. This data can be found on pages 16-17, 21, 24, 28, 31-32, 34, 39, 43, 47, 50-51, 54-55, 60, 63, 65-66, and 68-69 of the Bitterroot River Section 7 Watershed Baseline (USDA Forest Service, 2000a). The reader should consult the Watershed Baseline for a comprehensive description of pre-fire fish habitat in the Bitterroot River basin. This assessment will focus on how fish habitat is expected to change as a result of the fires.

Fish habitat surveys have yet to be conducted in the burned streams since the end of the fires. However, elsewhere in the west, numerous post-fire studies of streams have occurred since the 1988 Yellowstone Fires (Gresswell, 1999). Based on that research and the forest's ongoing post-fire aquatic monitoring of the 1996 Swet Fire in the Selway River basin (USDA Forest Service, 1997: 73; USDA Forest Service, 1999: 99-101), some general habitat trends can be predicted based on burn severity. These trends include:

**Woody debris recruitment.** In the moderate and high severity sections of stream, woody debris has increased from burned trees falling into streams or from snags felled during the suppression effort. Woody debris is likely to continue to increase for one to two decades in these streams (Minshall et al., 1990; Young, 1994; Reeves et al., 1995; USDA Forest Service, 1999: 99-101). A good example of a woody debris increase in a moderate severity burn can be seen by driving along the East Fork between the Spring

Gulch campground and Sula. Where no live trees remain along severely burned streams, woody debris will increase sharply for one to two decades, but then be followed by at least 50 years of no woody debris recruitment. In these severely burned streams, woody debris recruitment will not approach pre-fire levels until the new forest canopy has matured and starts to fall.

Because of the increase in woody debris, more pools and spawning gravel beds are expected to form over the next 20 years, which will improve habitat for native fish (Swanson and Lienkaemper, 1997; Minshall et al., 1997) **(Figure 3-5, Appendix B)**. In the severely burned streams, there will eventually be a reduction in pools after 5 to 6 decades when the woody debris from these fires has rotted and has not been replaced by new material falling into the channel. In the low severity streams, woody debris recruitment from these fires is likely to be minimal. Woody debris and pool changes in the moderate severity streams are expected to be very patchy and intermediate to those of the low and high severity streams.

**Sedimentation and turbidity.** Physical changes to fish habitat are likely to occur in the burned streams during the first five years following the fire, and then gradually decline in frequency and magnitude as the burned area re-vegetates (Gresswell, 1999). The most noticeable changes are increased sediment and ash deposition in the stream bottoms (Beschta; 1990; Minshall et al., 1990; Beaty, 1994), and periods of extensive turbidity following rainstorms (Bozek and Young, 1994). In general, sediment following fires will persist for longer periods in smaller streams (1st and 2nd order) than larger streams (3rd order or greater) (Robinson and Minshall, 1993). The largest sediment increases will occur adjacent to and downstream of the moderate and high severity burns. The duration of the sediment increases is likely to be less than 5 years (Robinson and Minshall, 1993), followed by a gradual cleaning of the stream bottom. Monitoring of the 1996 Swet Fire indicates that most of the large sediment and ash deposits that were visible one year after the fire were no longer present three years after the fire (USDA Forest Service, 1999: 99-101) **(Figure 3-6, Appendix B)**.

For the first three years after the Swet Fire, turbid water produced by the Wilkerson Creek drainage during storms was visible far downstream in the Selway River **(Figure 3-7, Appendix B)**. The Wilkerson Creek drainage stopped producing turbid water 3 to 4 years after the fire (unpublished Bitterroot National Forest monitoring data). Since the start of the autumn rains, turbidity has occurred in the East Fork, but it has been minor. The tributaries that appear to be contributing the most turbidity to the East Fork at this time are Medicine Tree Creek, Laird Creek, Camp Creek, and Cameron Creek. The combined discharge of all these streams is a small percentage of the total discharge of the river, which means that large plumes of turbidity in the East Fork may not occur unless some of the larger tributaries (e.g. Tolan Creek; Meadow Creek; upper East Fork) start producing turbid water in the future.

In the low severity streams that have little to no moderate/high severity burned area upstream, sedimentation is expected to be invisible and immeasurable, and fire-caused turbidity is likely to be minimal in its concentration, duration, and extent of spread.

**Stream channel erosion.** Along severely burned streams, fish habitat is likely to be altered by higher stream flows for at least a decade. Possible changes include increases in stream width and/or depth, and losses of undercut bank cover (Minshall et al., 1990; Robinson and Minshall, 1996). Monitoring of the 1996 Swet Fire indicates that channel erosion occurred during the first three years after the fire, and the eroding stream banks may have been one of the largest sources of the thick turbidity that was visible at least 20 miles downstream in the Selway River following major storms (unpublished Bitterroot National Forest monitoring data) **(Figure 3-8, Appendix B).** Despite the increased erosion of stream banks in some areas, large inputs of woody debris help to counteract the effects of channel erosion by trapping bedload, narrowing other portions of the channel, and forming new undercut banks. On the watershed scale, these changes in channel morphology tend to increase the complexity of fish habitat over time, which is beneficial to the fishery (Everest et al., 1987; Reeves et al., 1995).

**Landslides.** Landslides (also called debris torrents) could occur in some of the most severely burned streams given the right combination of intense precipitation and hydrophobic soils **(Figure 3-9, Appendix B).** In the first year following the 1996 Swet Fire, landslides in several small tributaries caused sediment inputs to Wilkerson Creek and Storm Creek (USDA Forest Service, 1997: 73). In 1992, post-fire landslides caused a large fish kill in Overwhich Creek (USDA Forest Service, 1992: 19-23; USDA Forest Service, 1993: 65). In the past decade, post-fire landslides have caused large, documented fish kills in Montana (Novak and White, 1990), Wyoming (Bozek and Young, 1994), Idaho (Rieman et al., 1997), Arizona (Rinne, 1996), and New Mexico (Probst et al., 1992). Although landslides appear catastrophic in the short term, these events are important in maintaining long term habitat complexity and suitable spawning and rearing areas because they input large quantities of spawning gravel and woody debris to streams (Everest et al., 1987; Reeves et al., 1995) **(Figure 3-10, Appendix B).**

Since the start of the autumn rains, several minor landslides have occurred in the Sula Peak area, the Little Sleeping Child Creek drainage, and the North Rye Creek drainage. At the time of this writing, no large landslides are known to have occurred on the forest since the end of the fires. The threat of landslides will, however, continue to be very high for the next couple of years. The threat will probably be highest during the thunderstorm season of 2001 (i.e. May through September), and then gradually subside in following years as the burned slopes revegetate and stabilize. Thunderstorms have a better chance of causing landslides than spring/autumn rains and snowmelt because they can produce intense rainfall over short durations that the burned soils simply cannot absorb. The thunderstorms that caused the Overwhich landslides in June and July 1992 dumped over an inch of rain in less than 20 minutes on water repellent soils (USDA Forest Service, 1992: 18-20).

**Water temperatures.** In streams where most of the shade cover was burned off, summer water temperatures are likely to increase for at least a decade until the riparian shade cover recovers to pre-fire levels (Gresswell, 1999). Maximum daily increases ranged

between 3 and 10° C in intensively burned headwater streams in Washington and Oregon (Helvey, 1972; Amaranthus et al., 1989).

Although stream temperatures usually increase following fire, predicting the biological consequences is difficult. Effects depend on many variables, including burn intensity, spatial pattern of the burn, stream size, aspect, elevation, and the types and sizes of aquatic organisms affected (Gresswell, 1999). For instance, in some low elevation burned streams, warmer stream temperatures are likely to favor non-native trout species that are more tolerant of warmer temperatures (brook trout, brown trout, and rainbow trout) over native bull trout and westslope cutthroat trout, which do better in colder water. In higher elevation areas where low water temperatures limit primary production, warmer stream temperatures following canopy burning may increase the productivity of native fish populations for several years until shade returns (Albin, 1979; Minshall et al., 1990).

**Nutrients**. Immediately after a fire, streams adjacent to burned areas often exhibit rapid post-fire peaks of nitrogen and phosphorus that generally last no more than a few weeks (Fredriksen, 1971; Brown et al., 1973). These nutrients can remain elevated for several years because the loss of vegetation following fire can interrupt the cycling of nutrients in a forest, and subsequently, exports to streams are increased (Bayley et al., 1992; Brass et al., 1996; Robinson and Minshall, 1996). When nutrient exports to streams are high, primary productivity and aquatic insect populations boom, and fish grow large quickly. As vegetation becomes reestablished, fewer nutrients are available for leaching, soil erosion declines, and nutrients in streams usually decrease to pre-fire levels (Gresswell, 1999).

***Table 3-2. A summary of the effects of low, moderate, and high severity fire on fish habitat.***

| Fish habitat variable | Low severity burn | Moderate severity burn | High severity burn |
|---|---|---|---|
| Large woody debris | Little to no recruitment of woody debris following fire, Future recruitment rates similar to pre-fire conditions | Post-fire recruitment of woody debris is intermediate and patchy; Long term recruitment is more consistent than in the high severity areas because some of the surviving mature trees will die and fall into streams while the burned canopy recovers | Large pulses of woody debris recruitment during the first two decades, followed by almost no recruitment for at least 80 years until mature trees are back on the site |
| Pools | Little to no change from pre-fire conditions | Some increase in pools, but patchy and not as much of an increase as would occur in the high severity areas | Over time, a large increase in pools will occur because of the large input of woody debris |
| Spawning gravel (quantity and location) | Little to no change from pre-fire conditions | Over time, some increase is likely where new pools are formed; particularly in the lower gradient streams | Over time, a large increase could occur in the areas where a large input of woody debris occurred; particularly in the lower gradient streams |
| Sediment | Negligible increases because of fire | Similar to high severity, but less area affected | Large increases are likely for < 5 years, followed by a gradual return to pre-fire levels |
| Turbidity | Negligible and not likely to occur; if it does, it will be very light, localized, and of short duration | Turbidity will be intermediate in concentration, extent, and duration; not likely to occur after 1-2 years following the fire | Large plumes of turbidity are likely to occur after major storms for 3-4 years following the fire |
| Stream channel alterations | Stream channel erosion is not likely to occur; channel shape remains at or near pre-fire condition | Similar to high severity, but less area affected | In some areas, channel widening and loss of undercut bank cover is likely to occur because of higher stream flows; in other areas, woody debris will trap bedload and narrow channels |
| Risk of landslides | Very low risk | Similar to high severity, but less area affected; the risk is highest in the steep draws | High risk for the first 2 years following the fire; risk is highest during the summer thunderstorm season, with the right combination of intense rain and burned soils, could be a very large landslide |
| Water temperatures | No change from pre-fire conditions | Similar to high severity, but less area affected and smaller temperature increases | Maximum summer temperatures increase by 3-10° C for at least a decade until the pre-fire shade returns; increases are highest in the smaller streams, but shorter in duration |
| Nutrients | Negligible increase in N and P for several weeks, followed by a quick return to pre-fire levels | Similar to high severity, but less area affected and lower peaks of N and P | N and P peaks sharply for several weeks following the fire, stays high for several years, and then gradually declines to pre-fire levels as vegetation recovers |

As a general rule, habitat changes following fire are more variable and will persist longer in smaller streams (1st and 2nd order) than larger streams (3rd order and greater) (Robinson and Minshall, 1993). This applies to all burn severities.

### *4.3.4.6 Effects on Key Spawning Areas*

Little is known about key spawning areas for resident bull trout and westslope cutthroat trout on the Bitterroot National Forest. These fish are small (most are less than 10 inches in length) and tend to spawn in dispersed pockets of suitable gravel wherever the species are present. Low gradient sections of stream tend to be favored because they contain the best spawning gravels. The redds are small and difficult to detect. It is probably safe to assume that wherever resident bull trout and westslope cutthroat trout are present, some spawning is probably occurring nearby. Some known key spawning areas for resident fish include:

- the middle section of Daly Creek (unburned, mostly low severity burn upstream of the spawning area);
- Skalkaho Creek upstream of Daly Creek (unburned below Weasel Creek, moderate and high severity upstream of Weasel Creek); and,
- the upper half of Sleeping Child Creek (mix of all severity classes).

Since 1998, MFWP and Bitterroot National Forest have attempted to pinpoint key spawning areas for migratory bull trout and westslope cutthroat trout in the East and West Fork drainages by radio tracking adult fish and conducting redd surveys (USDA Forest Service, 1998: 88-91; USDA Forest Service, 1999: 96-98) **(Figure 3-11, Appendix B)**.

The MFWP radio tracking data has indicated that the following areas are probably important spawning areas for migratory bull trout and westslope cutthroat trout:

- The low gradient sections of the East Fork and its tributaries above the East Fork trailhead and below Star Falls (mostly low severity along the East Fork, but greater areas of moderate and high severity in the tributaries);
- The middle section of Meadow Creek (unburned, some high severity in the headwaters several miles upstream);
- The lower third of Moose Creek and possibly Martin Creek (unburned);
- Swift Creek between its mouth and Dense Creek (mostly unburned below the Swift-Dense confluence, but mostly high severity above the confluence);
- Warm Springs Creek between the Crazy Creek campground and Sheep's Head Creek (mix of low severity and unburned);
- Tin Cup Creek between the forest and wilderness boundaries (unburned);
- The Nez Perce Fork and the lower ends of its major tributaries (unburned); and,

- Low gradient sections of stream scattered throughout the upper West Fork drainage, including Slate (high severity in headwaters), Overwhich (mixed severity in headwaters), Hughes (mostly low severity in headwaters), Sheep (unburned), Beaver (unburned), Woods (unburned), Deer (mostly unburned, some low severity near mouth), and Blue Joint Creeks (mostly unburned, some mixed severity near mouth).

Generally, key spawning areas for migratory fish are probably also key spawning areas for resident bull trout and westslope cutthroat trout. Maps 3-1 and 3-2 in Appendix C display key bull trout and westslope cutthroat trout spawning areas in relation to burn severity.

The effects of the fires on key spawning areas are likely to be very patchy. Where large areas of moderate and high severity burn are adjacent to and upstream of the spawning grounds, expect large sediment and ash deposits to occur in the stream bottom and some degradation of the spawning gravels for at least 2 to 5 years. Egg survival rates are likely to be poor in those areas compared to pre-fire levels. Reductions in egg survival because of fire-caused sedimentation should be a temporary condition that peaks 2 to 3 years after the fire and then gradually declines to pre-fire levels. In the unburned and low severity spawning areas, it is unlikely that the fires will have any measurable impact on spawning gravel quality or the sizes of bull trout and westslope cutthroat trout populations.

In the Bitterroot River basin, the key bull trout and westslope cutthroat trout spawning areas that are most likely to be impacted by fire-caused sedimentation are the upper East Fork near Buck and Carmine Creeks, Swift and Dense Creeks, upper Skalkaho Creek, middle Sleeping Child Creek, and the upper halves of Slate Creek and Overwhich Creek. These areas are displayed on Maps 3-1 and 3-2 in Appendix C.

In the Selway and Salmon River basins, the low gradient sections of the Selway River, Salmon River, and their larger tributaries provide key spawning and rearing habitat for bull trout, westslope cutthroat trout, steelhead, and chinook salmon.

### *4.3.4.7 Effects of Fires of 2000 vs. Natural Range of Effects*

With the exception of the dry, low elevation ponderosa pine stands, the fires of 2000 probably burned within the range of natural viability across the forest. Fire intensity in most of the riparian areas was patchy, as would be expected. Some riparian areas burned very hot, while other nearby areas were unburned. None of the fish-bearing streams were severely burned over their entire length. Approximately 20 percent of the fish-bearing drainages had at least 25 percent of their fish-bearing stream miles burned by moderate and high severity fire.

The native fishery on the forest has persisted and flourished for thousands of years in the presence of periodic large fires. On that time scale, the fires of 2000 may have only

been a 100- to 200-year event. The last time the forest was burned on this scale was in 1880's. Research has consistently shown that native fish populations are adapted to even the most destructive fires as long as all of the life history forms are present in the populations, and the populations are connected to each other (Gresswell, 1999). In the Bitterroot River basin, the major difference between 1880's and 2000 is that some of the bull trout and westslope cutthroat trout populations are now isolated and no longer contain the migratory life history form. As a result, these isolated populations are less resilient to fire than they were a century ago.

### *4.3.4.8 Cumulative Effects on Native Fish Populations and Habitat*

Fire-caused sedimentation could have a cumulative effect on native fish in some of the "sensitive" and "high risk" watersheds that contain brook trout and had a large proportion of their drainage area burned at moderate and high severity.

Bitterroot National Forest hydrologists rate all of the watersheds on the forest as either "healthy", "sensitive", or "high risk" (Decker, 1991). The watersheds rated as "high risk" contain high road densities, numerous stream crossings, and have had timber in a considerable proportion of their drainage area harvested in the past. They have unnaturally high sediment and water yields, with poor fish habitat that is well below its natural potential. "Sensitive" watersheds contain better fish habitat than "high risk" watersheds, but habitat quality is still below its natural potential, usually because of sedimentation. Bull trout presence on the Bitterroot National Forest is strongly related to watershed risk rating. Bull trout are present in more than 90 percent of the "healthy" and "sensitive" watersheds, but only about 20 percent of the "high risk" watersheds (Clancy, 1993).

In the "sensitive" and "high risk" watersheds that had a large proportion of their drainage area burned with moderate and severe fire, sediment levels are going to get higher for at least the next one to three years. These watersheds are also going to be vulnerable to landslides and road failures for several years. Native fish recovery is likely to be slower, and displacement by brook trout will be a threat in these watersheds. The brook trout is a highly competitive non-native species that is better adapted to degraded habitats than bull trout and westslope cutthroat trout, particularly higher sediment levels and warmer water temperatures. In contrast to bull trout, brook trout are present in about 90 percent of the "high risk" watersheds, but less than 50 percent of the "healthy" and "sensitive" watersheds (Clancy, 1993).

The "sensitive" and "high risk" watersheds where bull trout and/or westslope cutthroat trout populations are at risk from sedimentation and displacement by brook trout include:

- the Little Sleeping Child Creek drainage (sensitive – brook trout common)
- the Rye Creek drainage (high risk – brook trout abundant)
- the North Rye Creek drainage (high risk – brook trout common)
- the Medicine Tree Creek drainage (sensitive – no brook trout)

- the Laird Creek drainage (high risk – brook trout common)
- the Camp Creek drainage (mix of sensitive and high risk – brook trout common)
- the Cameron Creek drainage (high risk – brook trout abundant)
- the Guide Creek drainage (high risk – no brook trout)
- the Jennings Camp Creek drainage (high risk – no brook trout)
- the Reimel Creek drainage (sensitive – brook trout common)

Bull trout are present in only three of the watersheds listed above: Rye Creek (rare), Laird Creek (uncommon), and Camp Creek (rare). Brook trout are present in all of the watersheds except for Medicine Tree Creek, Guide Creek, and Jennings Camp Creek. Westslope cutthroat trout are present in all of the watersheds, but densities vary by elevation and location in the watershed. In the lower stream reaches, brook trout are usually the dominant species over westslope cutthroat trout. In the middle and upper stream reaches, westslope cutthroat trout are still the dominant species over brook trout.

### *4.3.4.9 Effects on Amphibians and Aquatic Insects*

Four amphibian species commonly occur across the Bitterroot National Forest (Hendricks and Reichel, 1996: iii): boreal toad, *Bufo boreas*; tailed frog, *Ascaphus truei*; spotted frog, *Rana pretiosa*; and long-toed salamander, *Ambystoma macrodactylum*. All except the long-toed salamander were observed in some of the severely burned streams a few days after the fire. The long-toed salamander is usually found in ponds and lakes (Hendricks and Reichel, 1996: 6), so its lack of observation in the burned streams was not unusual. In Lyman Creek, large numbers of live boreal toads were observed along a severely burned section of stream bottom a few days after the fire (Kamps and Frank, 2000). There is little literature on fire effects on amphibians. We suspect that because amphibians are more tolerant of warmer water temperatures than trout, they may have survived the fires if they were able to get into the water when the streams were burned over. This would bode well for tailed frogs and spotted frogs, which seldom occur far from streams. However, boreal toads often occur considerable distances from streams, and it is questionable that they could survive a high severity fire by taking refuge under logs or rocks or in holes in the ground. Without more research on fire's effect on amphibians, we cannot adequately answer this question.

In recent years, a substantial amount of research has been conducted on the effects of fires on aquatic insects (Gresswell, 1999). This research indicates that in the first few years after a fire, the aquatic insect community is unstable and tends to fluctuate with the instability of the stream bottom (Cummins, 1978; Richards and Minshall, 1992; Lawrence and Minshall, 1994; Minshall et al., 1995; Mihuc et al., 1996). During this period of instability, total aquatic insect numbers may not differ much from those in unburned streams, but the insect community often changes from one dominated by shredders and collectors to one dominated by scrapers and filter feeders (Jones et al., 1993). After several years, when erosion rates decline and the stream bottoms stabilize,

aquatic insect productivity usually expands in response to increased light and water temperatures caused by the removal of riparian vegetation (Minshall et al., 1990).

#### *4.3.4.10 Fisheries in the Unburned Wildland-Urban Interface*

Across the forest, many fish-bearing streams bounded by narrow riparian corridors intersect the wildland-urban interface. The blocks of forested land between the stream corridors, where the vast majority of homes are located, are generally dry upland sites with few fish-bearing streams. Most of the fish-bearing streams that run through the interface offer good fish habitat on the forest side of the boundary, but much poorer habitat on private land. Dewatering, ditches and diversion barriers, high water temperatures, and non-native trout (especially the abundance of brook trout) are all major impediments to native fish on the private portions of the interface. Few bull trout populations still exist in the interface. North of Chaffin Creek on the West-side tributaries all of the remaining bull trout populations dwindle near the forest boundary and do not continue downstream onto private land. Westslope cutthroat trout are still the dominant fish species across much of the interface, but they too are much less common downstream on private land. In order to improve conditions for native fish in the interface, the major problems that need to be remedied are maintaining adequate instream flows, removing fish barriers, and restoring connectivity with the Bitterroot River. Only after these problems are solved can the issue of non-native trout be addressed. For more information on fish habitat and populations in the interface and on private land, consult the recently completed "Bitterroot River Section 7 Watershed Baseline" (USDA Forest Service, 2000a).

### 4.3.5 Objectives and Recommendations

#### *4.3.5.1 Objectives*

- Where fish kills occurred, bull trout and westslope cutthroat trout populations will recover to pre-fire levels within three years.
- In areas where fish kills did not occur, bull trout and westslope cutthroat trout population levels will remain stable (unmanaged watersheds) or increase over time (managed watersheds).
- In all watersheds, as the distribution and number of native trout expand, non-native trout will decline and eventually disappear.
- Existing man-made fish barriers will be removed, and native trout population connectivity will improve over pre-fire conditions.
- Instream flows will be obtained on private lands to reconnect fragmented populations.

- Migratory bull trout and westslope cutthroat trout will re-colonize streams where they are now absent.
- Fish habitat recovery in managed and unmanaged watersheds will be indistinguishable.
- Within several decades, fish habitat in all of the burned watersheds will have attained its full potential and will be in reference condition.
- Management actions will not hinder fish population and habitat recovery.

### *4.3.5.2 Recommendations*

1) Relocate the following encroached road segments. Obliterate, recontour, and revegetate the abandoned segments.

   a) FS Road #75 between FS Road #311 and FS Road #369 – relocate this connection by using FS Roads #311 and #369
   b) FS Road #321 between the Forest boundary and FS Road #1126 – relocate this connection by using FS Roads #75, #715, and #1126
   c) FS Road #723 between the Forest boundary and FS Road #5785 – relocate this connection to the East Fork Highway by using FS Roads #5786 and #5778

FS Roads #75 and #321 are joint ownership roads (Bitterroot National Forest and Darby Lumber Company). At the time of this assessment, the ownership of the Darby Lumber Company lands and roads is being contested in court, so any action on these roads would have to wait until an owner is established and all of the lawsuits have been resolved. If FS Roads #75 and #321 cannot be relocated, a fallback option would be to gravel the encroached segments.

2) Recontour and revegetate the old skid road that encroaches on Cat House Creek. The skid road is located on Bitterroot National Forest and Darby Lumber Company land. No action can be taken on the skid road until an owner of the Darby Lumber Company lands is established and all of the lawsuits have been resolved.

3) Eliminate fish barriers by removing the existing culverts and constructing bridges on the following road crossings:

   a) Gird Creek (FS Road #1365)
   b) Moose Creek (FS Road #726)
   c) Rye Creek (FS Road #5612)

4) Eliminate fish barriers by removing the existing culverts and constructing open bottomed arches on the following road crossings:

   a) Bugle Creek (FS Road #725)
   b) West Fork Camp Creek (FS Road #729)
   c) Sheep Creek (FS Road #6223)

5) Eliminate fish barriers by removing the existing culverts and replacing them with larger culverts on the following road crossings:

   a) Mink Creek (FS Road #5753)
   b) Mine Creek (FS Road #5688)
   c) Elk Creek (FS Road #13860)
   d) Malloy Gulch (County Road #104-D)
   e) Mill Gulch (County Road #104-D)
   f) Taylor Creek (County Road #104-D)
   g) Daly Creek, tributary 3.2 (Blade Creek) (State Highway #38)
   h) Gabe Creek (FS Road #468)
   i) Washout Creek (FS Road #6223)
   j) Magpie Creek (FS Road #362)

6) Eliminate fish barriers by removing the existing culverts on the following closed roads. After removing the culverts, re-contour and re-vegetate the stream crossings.

   a) Daly Creek, tributary 3.3 (Snow Pillow Creek) (FS Road #62622)
   b) Daly Creek, tributary 5.1 (Bear Scat Creek) (FS Road #5783)
   c) Mink Creek (FS Road #73313)
   d) Trout Creek (FS Trail #674)

7) Cooperate with local irrigation districts to reconnect fish populations in the Skalkaho and Sleeping Child drainages to the Bitterroot River by retrofitting and screening six existing irrigation diversions for fish passage. The Skalkaho Creek diversions include the Republican, Ward, Reeser/Thompson, and Skalkaho Highline diversions. The Sleeping Child Creek diversions include the Hedge diversion and an abandoned diversion (unnamed) near the mouth of Sleeping Child Creek. A description of the recommended retrofits is included in the fisheries section of the Skalkaho Complex BAER report.

8) Construct woody debris fish habitat structures in the following stream reaches. These reaches lacked woody debris prior to the fires.

   a) Hughes Creek (20 structures in the 1998 mine reclamation reach)
   b) Rye Creek (30 structures between FS Road #311 and FS Road #75 bridge)
   c) Overwhich Creek, tributary 4.7 (20 structures in lower 1000 feet)
   d) Malloy Gulch (20 structures in lower half mile)
   e) Mill Gulch (20 structures in lower 1000; remove two headcut drops)

f) Taylor Creek (20 structures in lower half mile)
g) Reimel Creek (20 structures between FS boundary and Wallace Creek)
h) Jennings Camp Creek (20 structures in lower mile)
i) North Rye Creek (40 structures between FS boundary and FS Road #1126)
j) North Rye Creek, tributary 2.1 (20 structures in lower 1000 feet)
k) North Rye Creek, tributary 3.4 (20 structures in lower 1000 feet)
l) North Rye Creek, tributary 4.3 (20 structures in lower half mile)
m) West Fork Camp Creek, tributary 0.1 (20 structures in lower half mile)

9) Modify two old woody debris fish habitat structures (one is a partial barrier) in Sand Creek (a tributary to Blue Joint Creek) below the Road #362 culvert.

10) Replant the appropriate conifer species along the following high severity stream reaches:

| | | |
|---|---|---|
| Little Blue Joint Cr | all high severity segments | 3.5 miles |
| Cow Creek | all high severity segments | 1.0 miles |

Assuming that planting would occur on both sides of the stream along a 100' wide corridor, the total acreage would be about 0.6 acres.

In all other burned riparian areas, do not plant trees – allow natural recovery to occur. Riparian areas dominated by shrubs are lacking on the Bitterroot National Forest, and should be allowed to play their natural role in recovery. Within the next two to three decades, conifers are likely to shade out and replace most of the shrub-dominated riparian areas that have been created by the fires.

### *4.3.5.3 Opportunities to Work with Citizens, Agencies, and Research*

- ✓ Where opportunities exist, work together with private landowners who wish to improve fish habitat on their burned lands
- ✓ Collaborate with research to determine what effect the fires will have on the competitive struggle between native and non-native trout
- ✓ Compare the recovery period for small, isolated native trout populations versus those of larger, well connected populations
- ✓ Determine what caused the fish kills that we observed in the high severity burn area
- ✓ Determine how much woody debris is contributed to larger streams by severely burned small tributaries
- ✓ Determine how post-fire treatments affect fisheries

- ✓ Determine the fires' effects on amphibians
- ✓ Work with the Montana Department of Transportation to relocate Camp Creek back into its historic channel, and keep fire-caused woody debris in the East Fork of the Bitterroot River. Most of this work would occur during the proposed March 2001 reconstruction of U.S. Highway 93 near Sula.

## 4.3.6 Regulations and Direction

On the Bitterroot National Forest, the standards and objectives for fisheries are contained in three documents:

- the Bitterroot Forest Plan (USDA Forest Service, 1987);
- the INFISH aquatic conservation strategy (USDA Forest Service, 1995a: A-6 to A-13); and,
- the PACFISH aquatic conservation strategy (USDA Forest Service, 1995b: C-9 to C-19).

The Bitterroot Forest Plan requires that habitat be provided to support viable populations of native and desirable non-native fish, and that the habitat needs of sensitive species and protection of threatened and endangered species is considered in all project planning (USDA Forest Service, 1987: II-3, II-21).

The Forest Plan, as amended by INFISH and PACFISH, contains eight fisheries goals (USDA Forest Service, 1995a: A-1, A-2; USDA Forest Service, 1995b: C-3, C-4). These goals are to maintain or restore:

1) water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems;

2) stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed;

3) instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges;

4) natural timing and variability of the water table elevation in meadows and wetlands;

5) diversity and productivity of native and desired non-native plant communities in riparian zones;

6) riparian vegetation, to (a) provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems; (b) provide adequate summer and winter thermal regulation within the riparian and aquatic zones; and (c) help achieve rates of surface erosion, bank erosion, and channel migration characteristic of those under which the community developed;

7) riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region; and

8) habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.

The Bitterroot Forest Plan was amended by two aquatic conservation strategies in 1995: (1) the Inland Native Fish Strategy (INFISH), and (2) the Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). INFISH and PACFISH contain identical standards and guidelines, the only difference is that INFISH applies to the Montana portion of the forest while PACFISH applies to the Idaho portion of the forest. INFISH and PACFISH contain much more restrictive standards than those originally written in the 1987 Bitterroot Forest Plan, and give fisheries a much higher level of protection. INFISH and PACFISH direct the forest to maintain or improve habitat for native fish by restricting the types of activities that can occur in riparian buffers.

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# Appendix A. Burned Drainages

Listed below are the named, fish-bearing streams burned on the Bitterroot National Forest during the summer of 2000.

**East Fork of the Bitterroot River drainage**
East Fork of the Bitterroot River
Medicine Tree Creek
Laird Creek (tributaries: Gilbert, Moon)
Warm Springs Creek (tributaries: Crazy, Fire, Sheeps Head, Wiles, Porcupine)
Maynard Creek
Camp Creek (tributaries: West Fork Camp, Andrews, Praine, Waugh)
Cameron Creek (tributaries: Lyman, North Fork Cameron, Hart, Doran)
Reimel Creek (tributary: Wallace)
Tolan Creek
Guide Creek
Jennings Camp Creek
Meadow Creek (tributaries: Balsam, Bugle, Swift, Dense)
Bush Creek
Lick Creek
Needle Creek
Orphan Creek
Mose Creek
Cub Creek
Carmine Creek
Sun Creek
Clifford Creek
Buck Creek (tributaries: Hope, Kurtz)
Alpine Creek
Park Creek

**West Fork of the Bitterroot River drainage**
West Fork of the Bitterroot River
Piquett Creek (tributaries: East Fork Piquett, Castle)
Blue Joint Creek (tributaries: Little Blue Joint, Took, Sand, Magpie, Fork)
Slate Creek
Overwhich Creek (tributaries: Trout, Corner, Straight, Drop, Shields)
Coal Creek
West Creek
Hughes Creek (tributaries: Taylor, Lake, Emmett, Colter)
Chicken Creek
Deer Creek

**Rye Creek drainage**
Rye Creek (tributaries: Lowman, Spring Gulch, North Rye, Fox, Cat House)

**Sleeping Child Creek drainage**
Sleeping Child Creek (tributaries: Little Sleeping Child, South Fork Little Sleeping Child, Rogers Gulch, Blacktail, Two Bear, Switchback, Divide)

**Skalkaho Creek drainage**
Skalkaho Creek (tributaries: Daly, Falls, Weasel, Bear Gulch)

**Blodgett Creek drainage**
Blodgett Creek

**Sheafman Creek drainage**
Cow Creek

**Selway River drainage**
Selway River
Sheep Creek
Indian Creek
Little Clearwater River (tributaries: Flat, Salamander, Lonely, Short; Chuckling; Lodge, Basin, Burnt Knob, Throng, Comb)
Magruder Creek
Kim Creek
Gold Pan Creek
Three Lakes Creek
Goat Creek
Witter Creek
Swet Creek
Thirteen Creek
Cedar Creek
Lookout Creek

**Salmon River drainage**
Salmon River
Elkhorn Creek
Fortune Creek
Big Squaw Creek
Harrington Creek
Black Creek
Sabe Creek (tributaries: Hamilton; Arrow)

## Appendix B. Photos

**Figure 3-1.** Little Blue Joint Creek electroshocking section in late July, 2000. Typical view of a high severity burn along a fish-bearing stream.

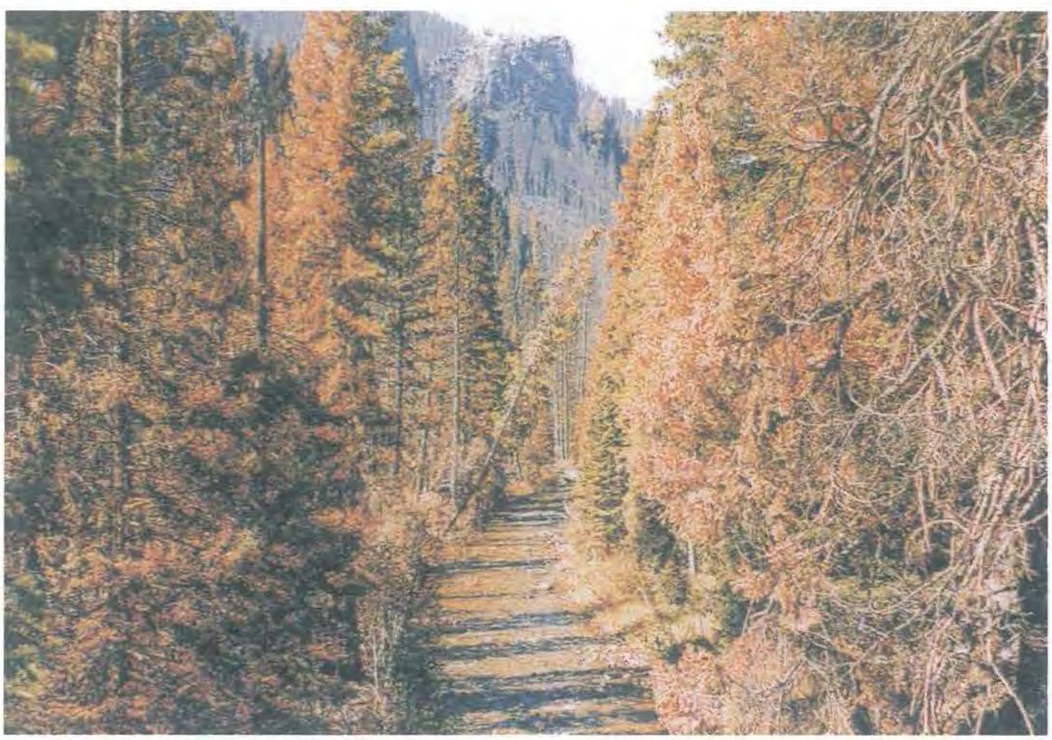


**Figure 3-2.** Blue Joint Creek in late July, 2000. Typical view of a mixed low and moderate severity burn along a fish-bearing stream.

**Figure 3-3**. Monitoring fish populations with snorkel surveys in Wilkerson Creek in August 1997, one year after the 1996 Swet Fire.

**Figure 3-4**. Monitoring fish populations with snorkel surveys in Wilkerson Creek in August 1999, three years after the 1996 Swet Fire.

**Figure 3-5.** Large quantities of woody debris were recruited to streams in the Wilkerson Creek drainage during the first year following the 1996 Swet Fire.

**Figure 3-6.** Extensive sedimentation occurred throughout the Wilkerson Creek drainage during the first year following the 1996 Swet Fire.

**Figure 3-7**. For the first 2 years after the 1996 Swet Fire, turbidity was thick in the Wilkerson Creek drainage for several days following rainstorms.

**Figure 3-11**. Radio-tagged migratory bull trout from the lower East Fork.

**Figure 3-8**. Stream channel erosion was observed throughout the Wilkerson Creek drainage during the first year after the 1996 Swet Fire.

**Figure 3-9.** Large landslide in the Wilkerson Creek drainage in August 1997, one year after the 1996 Swet Fire.

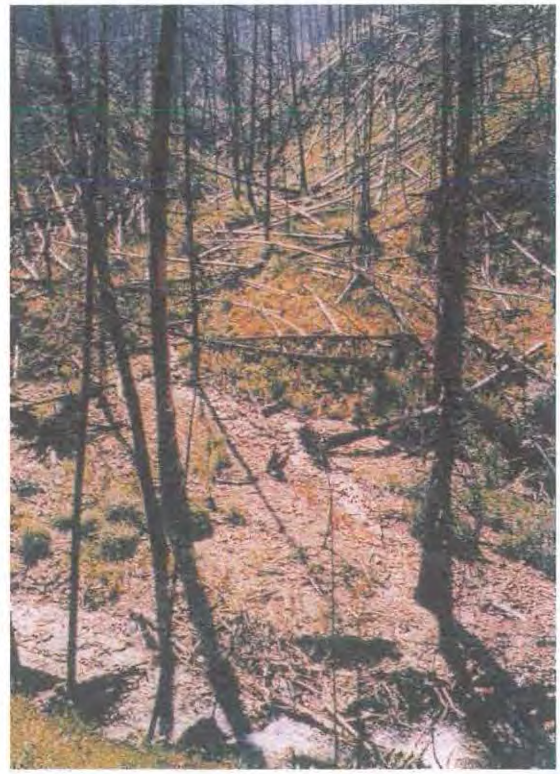
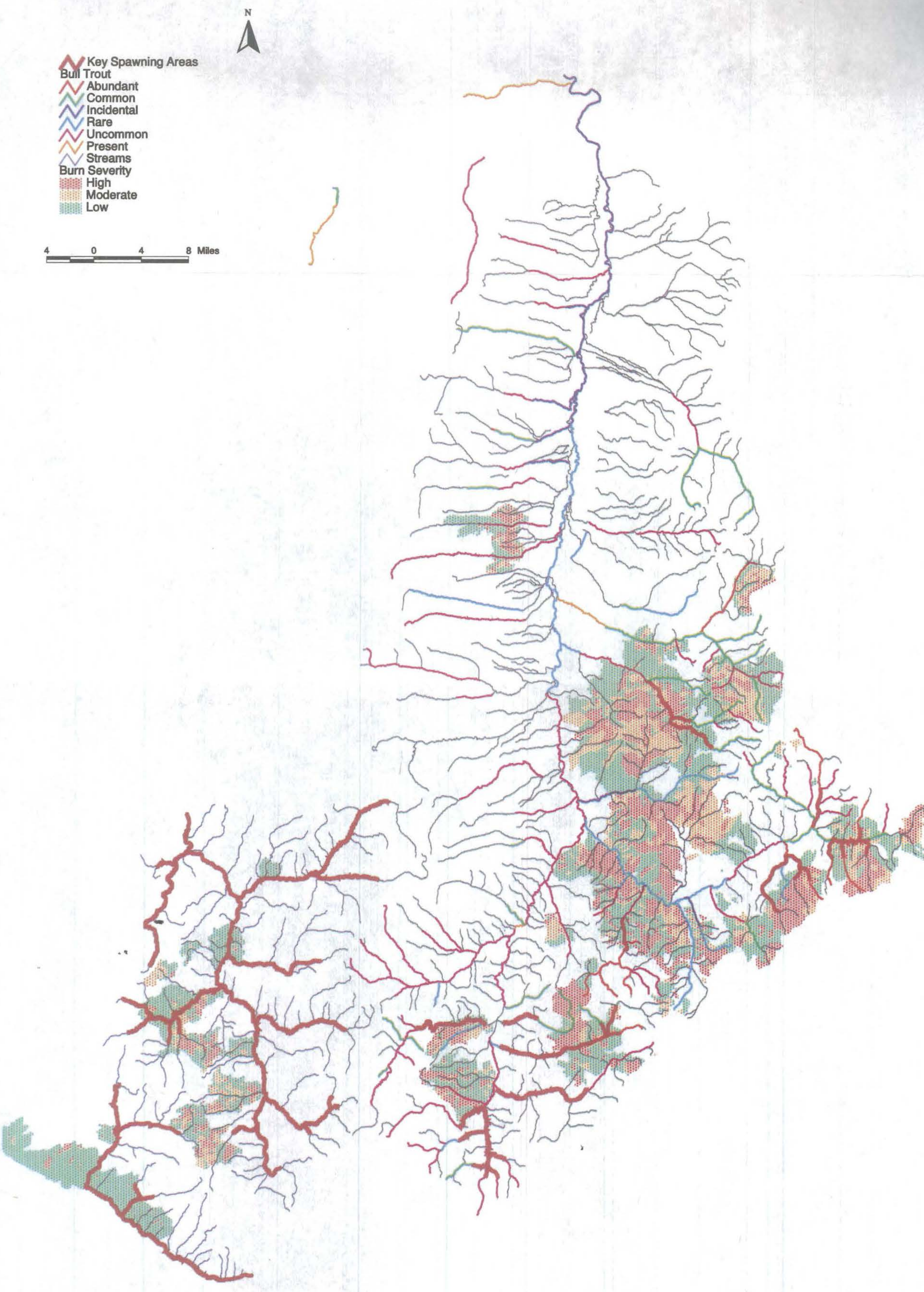
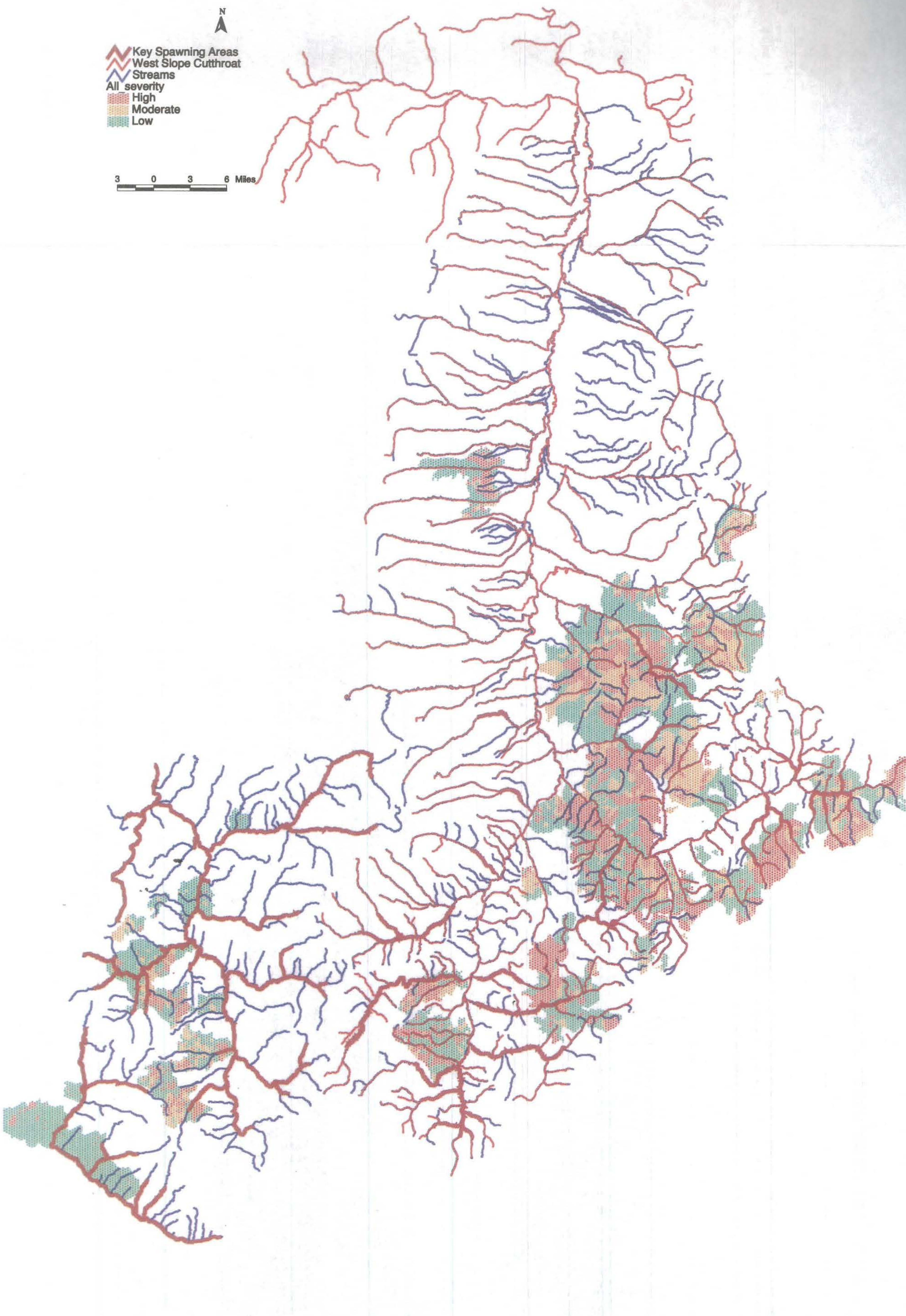


**Figure 3-10.** The same landslide in August 1999, three years after the 1996 Swet Fire.

Map 3-1: Bull Trout Distribution and Key Spawning Areas



Map 3-2: Westslope Cutthroat Trout Distribution and Key Spawning Areas



# 4.4 Wildlife

## 4.4.1 Background

### *4.4.1.1 Regional Context of Bitterroot Wildlife Habitat*

The Interior Columbia Basin Ecosystem Management Plan was established in January of 1994 through a charter signed by the Chief of the USDA Forest Service and the Director of the USDI Bureau of Land Management (USDA Forest Service 1996). The charter directed that work be undertaken to develop and adopt an ecosystem-based strategy for all Forest Service and Bureau of Land Management administered lands within the Interior Columbia Basin. The area encompasses about 145 million acres in Washington, Oregon, Idaho, western Montana and small portions of Nevada, Utah, and Wyoming. Fifty-three percent of the basin is public land administered by the Forest Service or Bureau of Land Management.

Of most significance to terrestrial vertebrates are the changes in terrestrial habitats and disturbance processes that have occurred across the Columbia River basin since the time of early European settlement. The most important of these changes are the dramatic shifts in fire regimes, reductions in area of native grasslands and shrublands, declines in the early and late stages of forest development, reduction in wetland area and deterioration of riparian habitat conditions, and increases in road density (Quigley et al. 1996, USDA Forest Service 1996, Hann et al. 1997). The assessment identified at least three major management practices, which have led to degraded habitats of terrestrial vertebrates.

- Large-scale, intensive timber harvest
- Large-scale exclusion of wildfire
- Widespread development of roads

Intensive timber harvest and management across the basin have substantially reduced the occurrence of early and late seral habitats and increased the occurrence of mid-seral habitats. The density of key structural features, such as snags and down logs over 20 inches in diameter, has decreased in all forested habitats. Most forested habitats have become increasingly fragmented, simplified in structure, and infringed on or invaded by exotic plants.

Large-scale exclusion of wildfire has changed the vegetative composition and structure of early and late-seral habitats, often favoring plant species that are ill adapted to many sites. A prime example is the closed stands of Douglas-fir that have replaced open stands of low-elevation ponderosa pine in many locations, including the Bitterroot Valley. These stand types differ greatly, not only in density and overstory species but also in the frequency and intensity of wildfires, insect infestations, and disease outbreaks. Wildfire is a major mechanism for recruitment of large snags and logs (Saab and Dudley 1998), and large-scale suppression of wildfire has led to a substantial reduction in the occurrence and density of large snags and large logs across extensive areas of the Columbia River basin (Hann et al. 1997)

Widespread development of roads has reduced habitat area, fragmented remaining habitat, and facilitated a substantial increase in human activities across large areas of the basin. Approximately 51 percent of the basin is estimated to support road densities considered to be moderate, high, or extremely high (Quigley et al. 1996).

## 4.4.2 Issues

- Should the fires of 2000 be considered natural events in relation to historic fire regimes?
- Where were the effects of the fires of 2000 within historic ranges and where were they outside?
- What influence did past management activities and practices have on fire behavior in 2000?
- What are the short-term consequences to wildlife from the 2000 fire season?
- What are the long-term consequences to wildlife from the 2000 fire season?
- How were lynx habitats affected and what role will these effects play on future habitat?
- What effect will the fires have on winter range management, especially thermal cover?
- Retention of large snags for wildlife habitat as well as for recruitment of large logs
- Old growth management
- Elk habitat effectiveness (ie. open road densities and loss of forest cover)
- Containment and prevention of noxious weed species such as spotted knapweed, sulfur cinquefoil, and leafy spurge
- Motorized access restrictions where disturbance may be detrimental to wildlife and their habitats
- Fire effects on bird species and their habitats

## 4.4.3 Historic and Pre-fire Conditions

### *4.4.3.1 Overview of Historic and Recent Habitat Changes*

The Bitterroot Valley has changed since European settlement began, as much as the rest of the Interior Columbia River basin has. Patterns of fire have changed; logging, grazing, agriculture, and exotic species have been introduced. Some of the earliest settlement in Montana occurred in the Bitterroot Valley in the 1840s, but significant effects on forest structure did not occur until the railroad arrived and mining began in Butte and Anaconda in the 1880s. By the 1890s, large parts of the Bitterroot Valley had been logged. By 1930, almost 22 percent of the valley had been logged, including 40 percent of the ponderosa pine and 14 percent of other forest types. Skid trails and stumps from this era can still be found throughout the valley. About 14 percent of the National Forest holdings were affected. The most rugged terrain in the Bitterroot Valley, including roadless and wilderness areas, has not had harvesting (Losensky, 1993).

The 1990s have been a different story. Road building, large-area fire suppression, and intensive logging were much less common than in earlier decades. Quite the opposite occurred, with the introduction of new management practices becoming the trend. Site-specific management with a narrow single-resource emphasis now takes a back seat to ecosystem-based practices designed with many resources in mind.

Intensive logging practices are also no longer a part of the management on the Bitterroot. Logging practices are managed to be lighter on the ground. Forest health is a driving issue, with disease and insect epidemics on the increase. Site specificity influences management decisions' less; rather, overall treatments are considered on a larger scale. Lack of thinning, formerly an effect of fire in drier sites, has led to overcrowded, less productive forests. Management focuses on long-term effects instead of short-term cures. Silvicultural management practices are designed to meet other resource needs, which was less of a factor in the earlier decades when timber production received more emphasis.

Widespread development of roads has not occurred on the Bitterroot since the late 1980s. Forest road systems are still highly visible on the forest; they are not, however, a reflection of recent management practices. Road systems were usually built in areas where there was easy access to timber stands, primarily in the ponderosa pine cover types. Many road systems have naturally re-vegetated over the years, thus becoming closed to motorized traffic. Roads have been "decommissioned" and obliterated over the years to protect resources'. Gates and seasonal restrictions are used in areas where access is a major issue.

### *4.4.3.2 Lynx Habitat*

The Bitterroot National Forest includes several types of lynx habitat. High quality lynx habitat in these mountains consists of a mosaic of early successional habitats with high hare densities and late successional stands with down woody debris for thermal cover, security, and denning (USFS 1994). Early successional stands usually have a better-developed understory than do mature forests and thus can support higher population densities of snowshoe hare, the primary prey of lynx. Hares also use logs and downfall on the edges of openings in mature forest to avoid avian predators. In winter, mature stands can also provide foraging opportunities for hares when snow cover allows the animals to reach overhanging branches normally above their reach. When hare populations decrease, lynx will turn to red squirrels as survival food (McKelvey 2000). Lynx are generally found in the Bitterroot at elevations above 6,200 feet.

### *4.4.3.3 Elk Winter Range*

The Bitterroot is rich in big game winter range. Elk herds winter in Sula Basin, calving and spending the summer and fall in higher country and on the neighboring Beaverhead-Deerlodge National Forest. About 2,000 elk spend the relatively mild winter in Sula Basin, migrating primarily from The Big Hole and Rock Creek drainages. Most elk that summer in the West Fork Bitterroot drainage winter in the Salmon River drainage in Idaho, but some winter in the West Fork. Six to seven hundred elk winter in

the area of Sleeping Child and Rye Creeks. Between Skalkaho and Sleeping Child Creeks, an area known as Beef Ridge annually hosts about 200 wintering elk (Firebaugh 2000). Much of the elk winter range in the main Bitterroot Valley (below Conner) is privately owned land. About a third to half of the elk that winter in the Valley move to the Rock Creek or Selway drainages in summer.

## 4.4.4 Effects and Implications of the Fires of 2000

### *4.4.4.1 Lynx Habitat*

The fires of 2000 altered lynx habitat on the Bitterroot National Forest. Both early successional foraging stands and mature denning habitat were affected. Table 4-1 displays, by ownership, the acreage of lynx foraging and potential habitat burned at each intensity level, and the percentage of total foraging or potential habitat burned. Burn intensity for several different geographic areas and resulting impacts to lynx habitat have also been compiled and are on file.

***Table 4-1. Forest-wide burn severity in lynx habitat by land ownership***

| Fire severity | | National Forest | | State | | Private | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | acres | % | acres | % | acres | % | acres | % |
| High | foraging habitat | 1,593 | 8% | 0 | 0% | 31 | 12% | 1,624 | 8% |
| | potential habitat | 36,808 | 10% | 11 | 8% | 154 | 5.5% | 36,973 | 10% |
| Mod. | foraging habitat | 801 | 4% | 8 | 100% | 92 | 35% | 901 | 5% |
| | Potential habitat | 26,329 | 8% | 48 | 36% | 455 | 17% | 26,832 | 8% |
| Low | foraging habitat | 2,465 | 13% | 0 | 0% | 115 | 44% | 2580 | 13% |
| | potential habitat | 46,605 | 13% | 0 | 0% | 1,457 | 54% | 48,062 | 13% |
| Total burned | foraging habitat | 4,850 | 25% | 8 | 100% | 238 | 91% | 5,096 | |
| | potential habitat | 109,742 | 30% | 59 | 44% | 2,066 | 77% | 111,867 | |
| Total habitat | foraging habitat | 19,973 | | 8 | | 261 | | 15,393 | |
| | potential | 361,245 | | 135 | | 2,677 | | 364,057 | |

Prior to the fires of 2000, lynx habitat on the forest was primarily composed of even-aged stands with little variation in stand structure. These even-aged stands burned in a mosaic pattern, creating a variety of stand structures. Unlike other organisms that are tightly linked to a particular forest condition, lynx use a variety of forest age and structural classes (Aubrey, 2000). By maintaining a variety of age and structural classes for lynx, a variety of habitat is created – denning habitat, travel corridors, and foraging habitat, from cone-bearing mature stands used by red squirrels to younger seral stands of lodgepole pine used by snowshoe hares (McKelvey, 2000).

Where stand-replacing burns occurred (high and moderate severity), there will be a dramatic increase in snowshoe hare populations in 15 to 20 years when natural regeneration of lodgepole pine begins to take hold. An increase in lynx populations will occur as hare populations increase. Stands burned at low to moderate severity will experience a noticeable change in vegetation, and foraging opportunities for snowshoe hares will increase where there is also cover for protection from hawks and owls. Short-

term reduction in prey species will not result in high mortality of lynx, primarily due to the habitat remaining where the forest was burned in a mosaic pattern and the large size of lynx home ranges.

### *4.4.4.2 Elk Winter Range*

Winter range on the Bitterroot National Forest burned in a mosaic pattern of mixed severity. Grass, hardwoods, and shrubs were observed to be re-sprouting within a few weeks of the fires. Recovery will take longer in the relatively low percentage of winter range where stand-replacing fires occurred. Elk will use some areas more heavily than in the past, especially riparian habitats and private land. More big game has already been observed in these areas this fall than in recent years; this trend will probably continue this winter and possibly next. Moderate severity burn areas are currently suitable for use as thermal and hiding cover. Low severity burn areas will continue to serve as winter range, offering thermal cover, foraging opportunities, and hiding cover. Elk movement patterns since the fires have been observed to focus on riparian, roadside, and private land due to the post-fire availability of fresh, nutrient-rich forage.

As a result of the fires, elk may begin to use some areas as winter range that they did not use before the fires. Across all ownerships in the burned area, 118,436 acres (61 percent) of the winter range burned, and 155,459 acres (47 percent) of the non-winter range burned. The use of non-winter range areas by elk can be viewed as either positive or negative – it may be due to the fall green-up in the non-winter range or to lack of forage in severely burned winter range.

Table 4-2 shows unburned and burned big game winter range and non-winter range for five analysis areas on the Montana portion of the Bitterroot National Forest.

***Table 4-2. Elk winter range burned & unburned by analysis area.***

| | National Forest (acres) | State (acres) | Private (acres) | Total (acres) |
|---|---|---|---|---|
| **Blodgett** | | | | |
| Elk winter range burned | 2,308 | 513 | 439 | 3,260 |
| Elk winter range unburned | 1,085 | 718 | 13,607 | 15,410 |
| Non-winter range burned | 7,813 | 22 | 352 | 8,187 |
| Non-winter range unburned | 42,856 | 0 | 35,881 | 78,737 |

***Table 4-2, continued***

| | | | | |
|---|---|---|---|---|
| **East Fork** | | | | |
| Elk winter range burned | 41,806 | 12,580 | 9,524 | 63,910 |
| Elk winter range unburned | 34,102 | 1,966 | 11,793 | 47,861 |
| Non-winter range burned | 42,116 | 520 | 9 | 42,645 |
| Non-winter range unburned | 68,167 | 97 | 661 | 68,925 |
| | | | | |
| **Skalkaho** | | | | |
| Elk winter range burned | 23,537 | 855 | 14,743 | 39,135 |
| Elk winter range unburned | 25,027 | 800 | 37,704 | 63,531 |
| Non-winter range burned | 59,789 | 643 | 8,310 | 68,742 |
| Non-winter range unburned | 54,530 | 20 | 17,482 | 72,032 |
| | | | | |
| **West Fork** | | | | |
| Elk winter range burned | 11,322 | 6 | 602 | 11,930 |
| Elk winter range unburned | 57,610 | 1,164 | 7,868 | 66,642 |
| Non-winter range burned | 35,766 | 0 | 119 | 35,885 |
| Non-winter range unburned | 111,782 | 12 | 836 | 112,630 |

Elk winter range was affected in both positive and negative ways. Before the fires, Douglas-fir encroached on much of the Management Area 2 (winter range) ponderosa pine stands and grasslands. Under these circumstances, shade-intolerant grass and shrub species decrease and forage becomes limited. High levels of fuel loading and ladder fuels in ponderosa pine stands allowed unnaturally intense burns to occur, resulting in loss of canopy cover that serves as thermal cover for big game species. In ponderosa pine stands adjacent to mixed conifer stands with heavy fuel loading, the same high severity burns unnaturally burned straight into the ponderosa pine canopies and created excessively high mortality that would not have occurred under more natural conditions. Fires thinned Douglas-fir in some winter range stands, while in other stands fire only crept along the ground and left excessively thick stands still in place. Historically, grasslands burned quickly and at low intensity, but this was not the case during the 2000 fire season. Fire crept through grasslands infested with spotted knapweed and often burned only in patches. In high severity burn areas, this disturbance will allow noxious weeds to get the upper hand on native vegetation, decreasing biodiversity and increasing non-productive habitats. To maintain open, park-like ponderosa pine stands, it will be necessary to continue to burn them.

Short-term losses of habitat occurred. Private landowners will feel the effects of this loss, with increased numbers of big game using their low-elevation timber and grasslands. One can only speculate on big game mortality that will occur because of habitat loss; however, big game species are adapted to fire and will use areas that were less frequented in the past to make up for the short-term habitat loss caused by the fires. With less hiding cover, they may be more susceptible to capture by hunters and predators. In the long term, forage and populations will increase. Some of the pressure from resident herds on private property will decrease when forage increases; the pressure will not stop, since big game often use private land as safe areas or game reserves during hunting season. Encroachment of undesirable tree species will still occur, and it will be necessary to continue thinning (either mechanically or with fire) to avoid re-creating the same problems.

### *4.4.4.3 Effects on Birds*

The fires of 2000 affected birds across a wide range of habitats, from riparian areas on the East Fork of the Bitterroot River to cliffs in Blodgett Canyon. The majority of birds on the Bitterroot are canopy dwelling species (Lockman, 2000); in the wake of canopy loss, species associated with habitats such as shrubs and grasses will move in.

Sensitive bird species that occur on the Bitterroot include northern goshawk, peregrine falcon, flammulated owl, and black-backed woodpecker. An active goshawk nest in the Skalkaho area that was found just before the fires was burned. A previously known goshawk nest located in the East Fork area was recently visited and found to be unaffected by the fires. The nest was not active this year, but the effects of fires in the general vicinity may or may not be a factor in nest occupation in the future. A peregrine falcon eyrie was located this season near Mill Creek in the Blodgett Fire area. Several flammulated owl territories are known to occur on the Bitterroot; these territories were primarily found in the low to mid-elevation ponderosa pine and Douglas-fir stands that were directly affected by fire. Conversely, the fires created many acres of habitat for black-backed woodpeckers.

The fires will have an overall beneficial effect on bird species and their habitats. Migratory bird species are primarily insectivorous and will benefit from increased insect populations and habitat diversification. Forest and grasslands burned primarily in a mosaic pattern, which will create habitat for a variety of bird species. Aspen clones will regenerate and expand, creating a greater overall diversity in habitats and wildlife species.

Flammulated owls and northern goshawks may be displaced from their territories; populations may decrease slightly, in the short-term. Black-backed woodpeckers are fire-dependent and their numbers tend to increase shortly after fire events. Beetle infestations are increasing on the forest where trees are stressed, either from fire events or competition; as a result, woodpecker populations will generally increase.

Woodpeckers will also benefit from the fire's creation of snags for nesting. Flammulated owls are secondary cavity nesters and may increase, in the long-term, where woodpeckers create nests.

### *4.4.4.4 Old Growth*

Before the fires of 2000, old growth habitat comprised about 40 percent of the Forest and was well distributed among habitat types and elevation zones, according to Forest Plan information. We know that many old growth stands burned at moderate to high severity, particularly at low elevations, but the lack of a Forest-wide database makes it impossible to accurately ascertain the extent of the loss. Field observations indicate most of the ponderosa pine old growth stands in the high and moderate burn severity classes now lack a seed source, so natural regeneration may take many years.

The fires of 2000 dramatically reduced the amount and distribution of old growth habitat on the Bitterroot Forest. Although we cannot accurately ascertain the extent of loss of old growth, it seems reasonable to assume it burned proportional to its distribution on the landscape. Within the fire perimeter about 50 percent remained unburned or burned with low severity fire and probably retained old growth habitat characteristics. About 50 percent of the area burned with moderate or high severity and therefore lost vegetation characteristics required of old growth. Therefore, if old growth habitat was evenly distributed among the burn severity classes, about 50 percent of the old growth should have been lost. It also seems reasonable, however, to assume old growth stands may have been burned more severely than the "average" stand because the old growth contains more decadent trees, snags, and coarse woody debris. It is likely that the forest lost more than 50 percent of the old growth habitat that occurred within the fire perimeters.

The reduction of old growth reduces habitat for species associated with old growth, most notably pileated woodpecker, marten, and lynx (denning habitat). On the other hand, habitat for northern three-toed and black-backed woodpeckers and species associated with early seral stage vegetation was dramatically increased.

Replacement of old growth habitat takes over 100 years. There are no shortcuts, but where the fires burned hot enough to eliminate seed sources we can start the recovery process by planting tree species ecologically appropriate for the site. Old growth habitats that remain have become extremely important; care must be taken to retain their integrity.

### *4.4.4.5 Snags and Coarse Woody Debris*

Large snags and large coarse woody debris now occur in abundance on the forest. Recruitment of large coarse woody debris and snags will continue to occur in the burned areas and around the perimeter of the fire. Beetle infestations were creating snags before the fires; the infestations began to increase after the fires in fire-stressed stands and will continue to increase.

***Table 4-5: Elk Security remaining after reductions for Moderate or High Severity fire, by Analysis Area (acres).***

| | Blodgett | East Fork | Skalkaho-Rye | West Fork | Anaconda-Pintler | Totals |
|---|---|---|---|---|---|---|
| High Severity | 1,028 | 15,601 | 5,756 | 10,971 | 7,450 | 40,806 |
| Moderate Severity | 186 | 4,512 | 6,333 | 2,651 | 4,785 | 18,467 |
| Security Remaining | 10,658 | 51,090 | 28,721 | 71,140 | 10,331 | 171,950 |
| Percent of Analysis Area | 12 | 27 | 18 | 41 | 54 | |

## 4.4.5 Objectives and Recommendations

### *4.4.5.1 Objectives*

Habitat requirements for all listed species on the Forest will be considered when prescribing post fire land management activities. Bald eagle, gray wolf and grizzly bear habitat was largely unaffected by the fires. Large areas of lynx habitat were burned, much of it with high severity fire. Fuel reduction projects would increase the success rate of reforestation efforts, and over time, would provide future hare and lynx foraging habitat. Large areas of burned forest would also be left to provide future lynx denning habitat.

Of the 11 sensitive species on the Forest, flammulated owl habitat was the most severely affected. Since they occupy mature and old ponderosa pine forests, their future depends on prompt reforestation of dry forests. We plan to closely monitor their response to the fires of 2000.

Other sensitive species have evolved with fire as a part of their history and probably little needs to be done to restore habitat. It is important to limit the spread of non-native vegetation, especially noxious weeds.

Land management prescriptions need to assure viable populations of all native and desirable non-native resident and migrant wildlife. Since the species present on the Forest have evolved with fire as a dominant force in shaping their habitat, "natural" recovery will be emphasized. Where treatments are implemented, we should assure the treated sites retain living and dead vegetation, primarily snags and down dead woody material, that will support species dependent on those habitat attributes.

### *4.4.5.2 Recommendations*

- Aerial spraying to control noxious weeds on big game winter range habitats
- Monitoring of sensitive species such as northern goshawk, flammulated owl, boreal owl, and peregrine falcon
- OHV restrictions in areas where disturbance may be detrimental to wildlife Give special consideration to elk hunting season security areas
- Retention of large snags and large logs for cavity nesters and seed cachers
- Shrub planting on areas burned at high severity where growth may be limited due to burn severity
- Maintain elk habitat effectiveness in areas where open road densities exceed forest-wide management standards
- Maintain old growth stands of 40 acres or larger distributed over the management areas in accordance with the Forest Plan
- Monitor land bird survey points that are established on the Forest
- Monitor displaced territories for nesting birds such as northern goshawk, flammulated owl, and boreal owl in unburned areas

### *4.4.5.3 Opportunities to Work with Citizens, Agencies, and Research*

- Study snag attrition rates in various habitats
- Determine woodpecker and other wildlife uses in stands where all, none, and various levels of snags are retained
- Conduct snowshoe hare population response and lynx habitat/prey research
- Conduct a follow-up study of flammulated owls, building on previous research and including fire effects
- Determine bird population response to post-fire habitats
- Study post-fire populations of small mammals

- Work cooperatively with Montana Department of Fish Wildlife and Parks to adjust hunting seasons or limits where big game security has been significantly reduced

## 4.4.6 Regulations and Direction

The Bitterroot National Forest Plan includes forest-wide management goals to: provide habitat to support viable populations of native and desirable non-native wildlife, maintain habitat for the possible recovery of threatened and endangered species, and to maintain riparian flora, fauna, water quality, and recreation activities (Forest Plan, 1987). The Bitterroot National Forest Plan also includes Forest-wide Management Objectives to: provide optimal habitat on elk winter range, maintain habitat to support viable populations of wildlife species, cooperate with the state of Idaho and Montana to maintain the current level of big-game hunting, maintain vegetative diversity on land where timber production is a goal of management, participate and cooperate in threatened and endangered species identification, recovery, and protection, and to maintain sufficient old-growth habitat diversity on suitable timberland to support viable populations of old-growth dependent species (Forest Plan, 1987).

Regulations concerning Threatened and Endangered Wildlife Species are contained in Section 7 of the Endangered Species Act (ESA). The U. S. Fish and Wildlife Service is responsible for reviewing all Forest activities to ensure that they are consistent with the ESA.

## 4.4.7 Literature Cited

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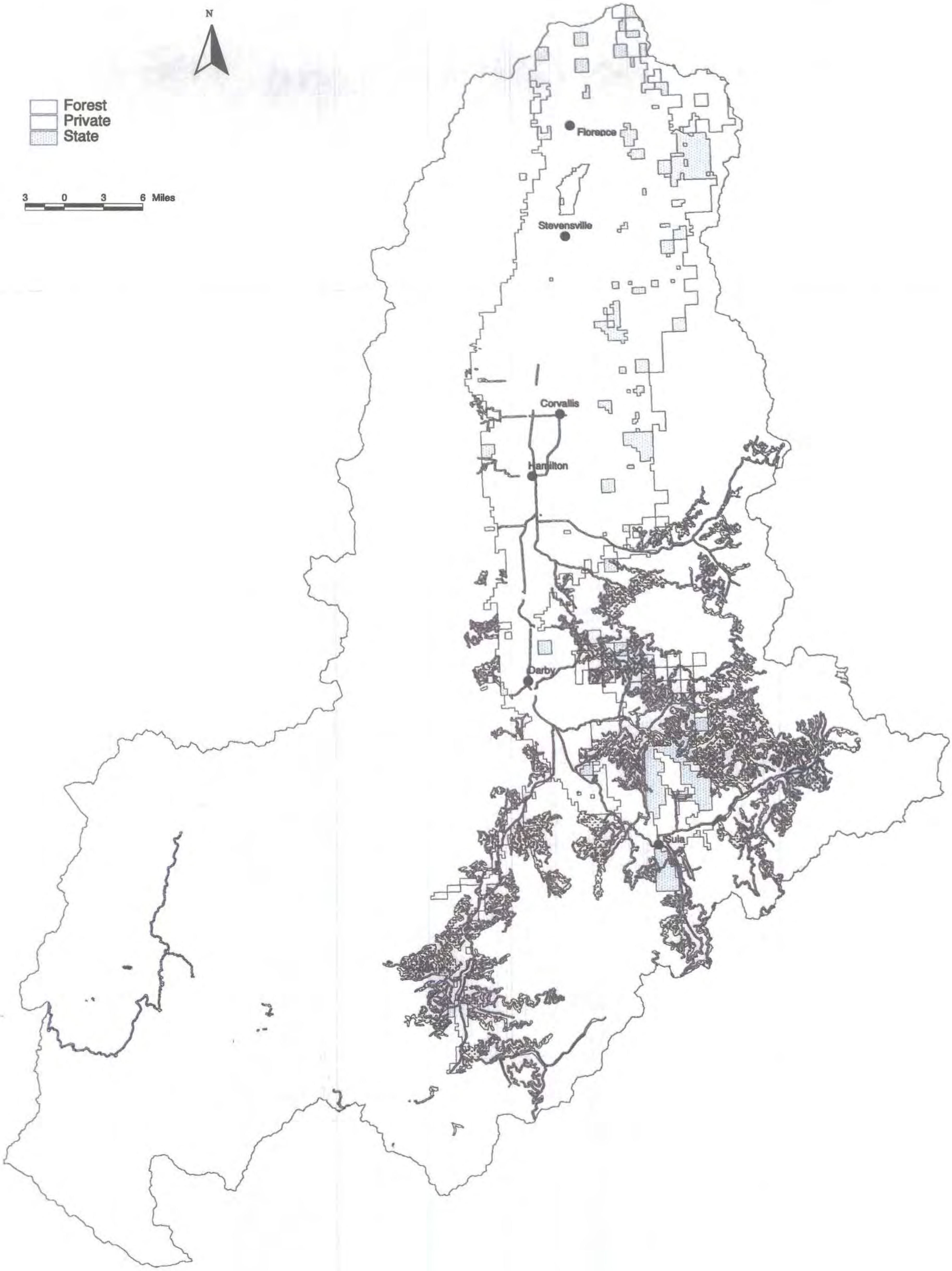
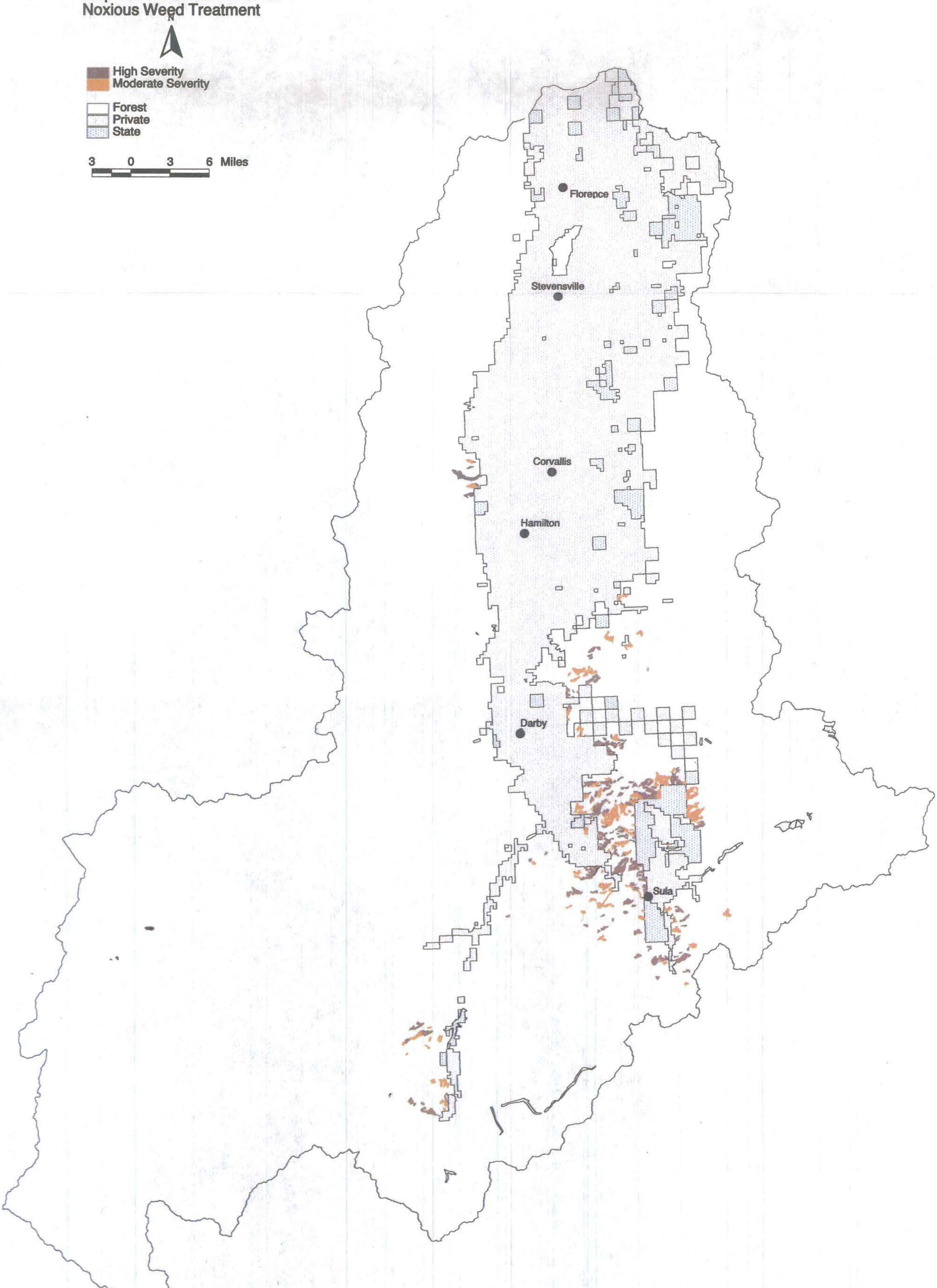
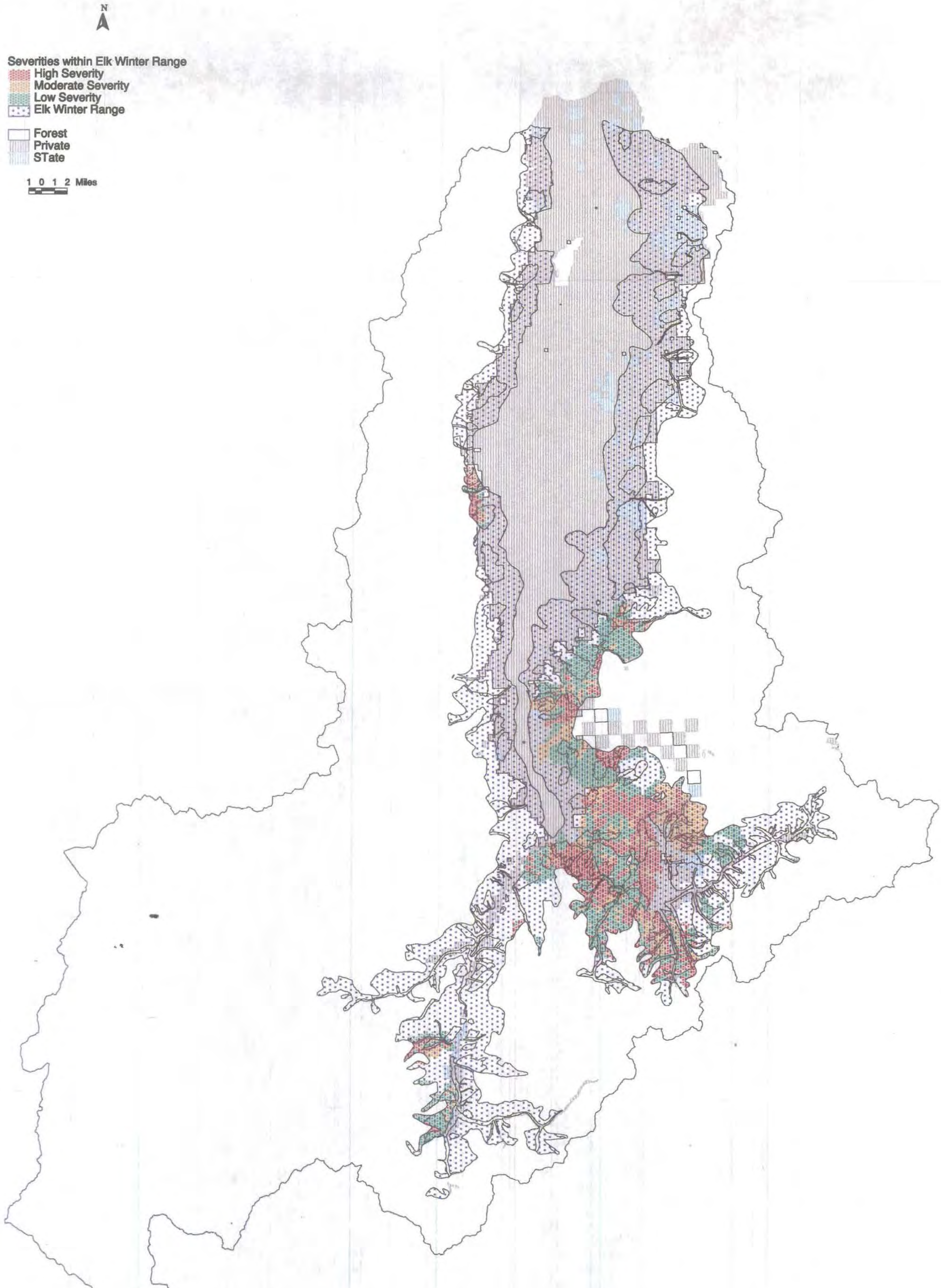
Map 4-1: Portions Of The Forest Greater Than 250' From Roads



## Map 4-2: Potential Areas for Noxious Weed Treatment



# Map 4-3: Elk Security Areas



# 4.5 Forested Plant Communities

## 4.5.1 Background

### *4.5.1.1 Introduction to Forested Plant Communities*

The Bitterroot National Forest is in the Middle Rocky Mountain Steppe/Coniferous Forest/Alpine Meadow Ecoregions in the Temperate Steppe Division of the Dry Domain (Bailey, 1994). At the sub-region scale, the area is in the Bitterroot Mountain Section (McNab, 1994). Steep dissected mountains with sharp crests and narrow valleys characterize the Bitterroot. Climate is cool and temperate with some maritime influence, producing relatively mild winters and dry summers. Most precipitation occurs as snow in the fall, winter, and spring. Potential natural vegetation is Douglas-fir forest, western ponderosa forest, and foothills prairie. Timberline occurs at about 8,800 ft. Common species include western larch, lodgepole pine, Douglas-fir, ponderosa pine, Engelmann spruce, subalpine fir, whitebark pine, alpine larch, cottonwoods, and aspen.

The combination of climatic, geophysical, and soil factors form the habitat types that are indicative of the ecosystem. Each habitat type represents a relatively narrow segment of environmental variation and delineates a certain potential for vegetative development (Pfister, 1977). Forests in this ecosystem rarely reach their potential climax vegetation due to natural disturbances (fire, insects, disease, windstorms) and man-made disturbances (land clearing, timber harvest).

Humans have influenced the ecosystem through logging, livestock grazing, agriculture, introduction of exotic species, and manipulation of fire. Some of the earliest settlement in Montana occurred in the Bitterroot Valley in the 1840s, but significant effects on forest structure did not occur until the railroad arrived and mining began in Butte and Anaconda in the 1880s. By the 1890s, large parts of the Bitterroot Valley had been logged. By 1930, almost 22 percent of the area had been logged, including 40 percent of the ponderosa pine and 14 percent of other forest types. Skid trails and stumps from this era can still be found throughout the valley. About 14 percent of the Forest Service holdings were affected. Only the most rugged terrain in the Bitterroot Valley, including roadless and wilderness areas, has not experienced the effects of logging (Losensky, 1993).

Since the early part of this century, humans have suppressed fires. Lack of fire has changed forest health, structure, and function. See Section 5.8 for more details.

Increased transportation and commerce worldwide has influenced the Bitterroot Valley through the introduction of noxious weeds and other pests such as white pine blister rust, which has had a large impact on the whitebark pine communities in the upper elevations in the Bitterroot.

## 4.5.2 Issues

- To what extent were the fires of 2000 "natural events", as compared to the historic fire regime?
- How did past harvest management practices influence on fire behavior of 2000?
- What was the fire's effect on forest health?
- What mortality can be expected in fire weakened trees in the next 2 to 5 years?
- What secondary fire effects could occur (e.g. Douglas-fir bark beetle, pine engraver beetle)?
- What are the effects of fire exclusion on forest structure, composition, diversity, and forestland integrity before the fires, and what does that mean now after the fires?
- What reforestation needs exist due to the fires of 2000? What exists in terms of need for planting, natural regeneration potential, seed source, species diversity, and site preparation? What is our success with natural and planting? How large of a program can we reasonably execute in the next five years?

## 4.5.3 Bitterroot River Drainage: Historic and Pre-fire Conditions

### *4.5.3.1 Vegetation Response Unit Overview*

Vegetation Response Units (VRUs) are probably the most meaningful ecological delineation for vegetation on the Bitterroot National Forest. VRUs are based on groupings of habitat types, and identify forested areas with similar fire regimes or disturbance patterns and vegetation potential, including species composition and stand structures.

A description follows of the five major VRUs represented in the Bitterroot, including historic fire frequencies and intensity. A map of the VRUs (Map 5-1) is located in Appendix B. The information on fire frequency and intensity is based on "Fire Ecology of Western Montana Forest Habitat Types" (Fischer and Bradley, 1987). Within any given forested VRU there are likely to be inclusions of non-forested sites (grasslands and riparian areas) where fire occurrence, intensity, and responses may differ from the majority of the VRU. Generally, grasslands in the cooler, moister VRUs historically burned more frequently than the timbered portion of the VRU, which is mainly a function of fuel size class. Riparian areas in all the VRUs usually burned less frequently and with less intensity, except during rare, very intense stand-replacing fires. References to historic conditions describe typical ecological conditions that existed prior to the period of fire suppression.

### *4.5.3.2 VRU 1: Grasslands*

Discussion of this VRU is included in Section 5.7 of this document.

### *4.5.3.3 VRU 2: Warm, Dry Ponderosa Pine and Douglas-fir Habitat Types*

These are steep, dry breaklands and benches that support ponderosa pine at the lower elevations and Douglas-fir at the higher elevations **(Figure 5-3, Appendix A)**.

**Historic conditions in VRU 2.** Generally, fires were frequent and non-lethal with a relatively uniform pattern. Average fire frequency ranged between 5 and 25 years (Fischer and Bradley, 1987). Pre-suppression composition and structure was typically open, park-like, multi-storied and multi-aged stands of ponderosa pine and/or Douglas-fir at higher elevations.

Historically, the warmest and driest sites, and areas that were moderately warm and dry occurring on low relief sites, were subjected to periodic ground fire with low to moderate intensity. These non-lethal ground fires typically would consume ground fuels and thin susceptible species in the lower tree canopy, usually consisting of Douglas-fir and sometimes lodgepole pine, while maintaining the existing overstory at low to moderate densities (Fischer and Bradley, 1987). Most importantly, these low intensity and frequent fires would perpetuate an open forested condition varying from single-storied to multi-storied structures. This maintenance/cycling fire regime was vital to the maintenance of forest structures, composition, and health keeping insects and disease at low levels.

Periodically, these burning events coincided with cone production in the overstory trees, producing a suitable environment for seedling establishment. However, the frequent burning would also occur at intervals where these small trees were susceptible (during the seedling sapling stage of development), thereby "thinning" the understory to relatively low densities. While small ponderosa pine can tolerate low intensity ground fires at intervals as short as 6 years, Douglas-fir is susceptible during the small tree stage due to thin bark and resin blisters (Fischer and Bradley, 1987). Consequently, the maintenance disturbance regime favored species compositions that included higher percentages of ponderosa pine than Douglas-fir.

Where canopy openings were not sufficient for establishment and growth of a new age class, the surviving overstory trees would rapidly reoccupy the available growing space (Oliver and Larson, 1996). Mixed or crown fires would occur between 50-500 years on moderate sites, and well over 1000 years between stand replacing fires on the driest sites. This fire regime maintained vegetation structures for long time periods. Shade intolerant seral species and relatively low fuels dominated stands. Snag densities were low and occurred as scattered

single individuals or small groups (Quigley et al., 1997; Bailey and Losensky, 1996 and Fischer and Bradley, 1987). Lethal, stand replacing crown fires would have killed most of the overstory, cycling the forests back to early seral conditions. These forests would have contained many fire-killed trees with scattered or grouped survivors that could persist for decades (Quigley et al., 1997).

The fire season was relatively long for both the maintenance and cycling regime variants, usually starting in June and extending into September (Quigley et al., 1997).

Native understory species included: bluebunch wheatgrass *(Pseudoroegneria spicata)*, Idaho fescue *(Festuca idahoensis)*, Scouler willow *(Salix scouleriana)*, common snowberry *(Symphoricarpus albus)*, spiraea *(Spiraea betulifolia)*, ninebark *(Physocarpus malvaceus)*, Oregon grape *(Berberis repens)*, Rocky Mountain maple *(Acer glabrum)*, serviceberry *(Amelanchier alnifolia)*, shiny-leaf ceanothus *(Ceanothus velutinus)*, Wood's rose *(Rosa woodsii)*, thimbleberry *(Rubus parivflora)*, arrowleaf balsamroot *(Balsamorhiza sagitatta)*, Indian paintbrush *(Castilleja spp.)*, and lupine *(Lupinus spp.)*.

**Pre-fire conditions in VRU 2.** The pre-fire condition of this VRU is very different than historic condition, due to the combined effects of over a half-century of fire suppression, introductions of non-native vegetation, and the active manipulation of vegetation by humans. The elimination of low/moderate intensity ground fires at relatively short intervals has had a dramatic effect on both the overstory and understory conifer vegetation. Without the periodic thinning influence of these fires, shade-tolerant trees (Douglas-fir) have developed in the understory and mid-canopy levels with relatively high stem densities. This change in historic stand structures can alter fire behavior effects. Instead of the open grown, single-layer native forests, the dense multi-layered forests provide an avenue for ground fires to move into the various canopy levels (ladder fuels), ultimately reaching the ponderosa pine/Douglas-fir overstory (Barrett, 1991; Agee, 1993) **(Figure 5-3, Appendix A)**. The elimination of low and moderate intensity fires has also increased fuel accumulations due to a combination of high tree densities, accompanying stress mortality, and elimination of the consumption of fine to medium sized fuels (Quigley et al., 1997).

Due to fire suppression, the ecosystem function of these altered landscapes are significantly different from the historic forests that evolved under the historic disturbance regime, including altered nutrient exchanges, carbon and hydrologic cycles and various wildlife/aquatic habitats (Kimmins, 1997; Quigley et al.,1997). These landscapes experienced reduced coverage of shade-intolerant shrubs due to increased tree densities, decreased nutrient availability for tree growth and maintenance, increased water stress, and increased insect/disease activity at levels beyond the historic levels before the fires of 2000. Root diseases are

prevalent across this VRU, associated with the increase numbers of Douglas-fir stems due to fire exclusion.

The understory vegetation also changed due to the elimination of fire, introduction of noxious weeds, and change in overstory vegetation structure. Instead of frequent nutrient cycling and re-sprouting of both shrubs and grasses, a general decline of palatable forage has occurred. Old, decadent woody stems have replaced the more succulent sprouts associated with repeated ground fires. Bluebunch wheatgrass (*Pseudoroegneria spicata*) can have reduced palatability due to fire exclusion (Bradley, 1986). The potential for higher intensity fires beyond what would have occurred under a natural succession/disturbance regime also increases the risk of reduced coverage of such species and thus, a risk of reduced forage production for a variety of large herbivores (Bailey and Losensky, 1996).

Infestations of spotted knapweed (*Centaurea maculosa),* a Montana state listed noxious weed, are now common in these open areas. Smaller populations of sulfur cinquefoil (*Potentilla recta)* exist throughout the lower elevations, and St. John's wort *(Hypericum perforatum*) and common tansy *(Tanacetum vulgare)* are scattered throughout as well.

North-facing slopes in lower elevations consist of Douglas-fir *(Pseudotsuga menziesia),* pinegrass (*Calamagrostis rubescens),* elk sedge *(Carex geyerii),* heartleaf arnica (*Arnica cordifolia),* and Rocky Mountain maple (*Acer glabrum).* Riparian areas and ephemeral draws contain species such as grand fir (*Abies grandis),* gray alder (*Alnus incana),* Engelmann spruce (*Picea engelmannia),* willow *(Salix spp.)* thimbleberry (*Rubus parviflorus),* and lady fern *(Athyrium filix-femina).* Scouler's willlow *(Salx scouleriana)* is scattered throughout the area.

### *4.5.3.4 VRU 3: Cool, Dry, and Moist Douglas-fir Habitat Types*

These are mid-elevation lands that lie between low elevation breaklands and high elevation stream headlands. Common tree species are Douglas-fir and, on moister sites, lodgepole pine. Ponderosa pine is a minor seral species in some areas.

**Historic conditions in VRU 3.** Historically fires were mixed with variable intensities ranging from frequent, low intensity, non-lethal, understory fires to infrequent, high intensity, lethal fires with a fire return interval of 25 to 100 years (Arno, 1993). To a degree, this VRU represents a transition zone between the non-lethal underburns common to VRU 2 and lethal (replacement) fire regimes common to VRU 4. Most burns are non-uniform and occur at a much smaller scale than in VRUs 1 and 2. Several non-lethal burns may occur on any given site that, under the right conditions, would then burn lethally. Fires historically played an important role in creating age/size class diversity across the landscape within this VRU.

This VRU is distinguished by cycling disturbance regimes, where both overstory and understory vegetation experience lethal events and are replaced by vegetation which cycles through a series of structural phases along multiple successional pathways. Wildfire was the most common disturbance which affected vegetation, although the fire season was relatively short, usually starting in July and extending into September . While most fires were very small, under drought conditions, occasional fires grew very large. In general, tree growth rates are fairly rapid, generating a short early successional stage (Fischer and Bradley, 1987; Quigley et al., 1997).

Pre-suppression composition and structure included a mix of even and multi-aged stands of Douglas-fir and/or lodgepole pine. Stocking ranged from fairly open to dense. The age and size differences between stands defined the edge which are still apparent in this VRU today. As evidence from this age/size mosaic, there were more early seral stands at the landscape level as well as some large patches of fire killed dead and down stands. This cycling fire regime created/maintained forest structures, composition, and kept insects and disease at low levels. The age/size class distribution at the landscape also kept insects and diseases at low to moderate populations levels by maintaining lesser amounts of susceptible stands in contiguous blocks.

Fire dynamics characterize the transition between those associated with VRUs 2 and 4. As a result of this transition, fire return intervals, intensities, and fuel loadings can range from 10 tons per acre to greater than 50 tons per acre depending on the vegetative successional stage and structure. Again intensities are dictated by the fire return interval and vegetative successional stage and structure in conjunction with fuel loadings, arrangement, continuity, and availability.

**Pre-fire conditions in VRU 3.** These forests have changed since the implementation of fire suppression and traditional harvesting practices. Traditional harvesting practices included the removal of vegetation through even-aged systems such as clearcutting or the removal of economic important trees, usually the large shade-intolerant trees in intermediate cuttings. Neither of these methods maintained the historical composition and structure associated with the native regime. Fire suppression has been particularly effective in this VRU, and has produced a shift in composition from shade-intolerant to shade-tolerant species, and has also altered stand structure by permitting overstocking of tree stems and the creation of additional canopy layers (Quigley et al., 1997).

The portion of this VRU that was harvested in the past generally simulated historic conditions with the exception of clear-cuts, which created single species and single storied stands. The unlogged or untreated portion of this VRU is generally densely stocked with an increased Douglas-fir component.

Associated understory species include shrub species such as ninebark, spiraea, blue huckleberry, kinnikinnick), pinegrass, elk sedge, pussytoes, heart-leaf arnica, wild strawberry, pyrola, western meadowrue, and twinflower.

Spotted knapweed is not as prevalent in this VRU, although some roadside populations can be found. Oxeye daisy and St. John's wort are more likely to be found in these areas.

#### *4.5.3.5 VRU 4: Cool Lodgepole Pine and Lower Subalpine Fir Habitat Types*

These are moderate to high elevation stream headlands. Sites are often dominated by lodgepole pine. Without disturbance, composition begins to shift toward shade tolerant species such as Engelmann spruce, Douglas-fir, and subalpine fir. Typically, growing seasons are limited by a combination of temperature (sites may experience frosts during the growing season) and moisture availability. Vegetation diversity is naturally limited by these conditions.

**Historic conditions in VRU 4.** Historically, fires were mixed with variable intensities ranging from periodic, low intensity, non-lethal underburns to infrequent, high intensity, lethal fires with a fire return interval of 30 to 200 plus years (Bradley, 1987). Secondary ecological processes, such as flooding, windthrow, diseases and insects, can make a substantial contribution to the available fuels.

Wildfires usually burned only during late summer, and most frequently in August (Quigley et al., 1997). Large wildfires in this VRU often followed extensive mortality in lodgepole pine from mountain pine beetle. Major infestations can be expected to occur when pine reaches 100 years old (70-150) (Bailey and Losensky, 1996). The large and severe burns would occur when a combination of fuel accumulation and climatic conditions intersected. Light underburns were also frequent on ridgetops maintaining the dominance of seral species. Mixed severity fires would occur either in a single fire event, or as a result of accumulated fire activity, resulting in several age classes distributed across the VRU. Other insect and diseases played a less active role in successional/disturbance regimes, probably thinning the stand of less vigorous individuals and accelerating the growth of residual trees.

The patterns fires left on the landscape are still evident. The resulting stands are even-aged, or where portions of the overstory survived, two-storied. Species composition varied from nearly pure stands of lodgepole pine to some mixed species stands of lodgepole pine, Douglas-fir, Engelmann spruce, and subalpine fir. Size and age classes varied from younger seedlings to mature trees with all classes well represented. Stocking varied from very dense in younger stands of

lodgepole pine to moderate or less in some mixed species stands. Multi-layered conditions would occur after long fire intervals, normally associated with basins and other protected areas. The periodic influence of fire suppressed the invasion and subsequent development of less fire tolerant species, limiting the occurrence of multi-layered structures in this VRU type. Double burns were also common in this type, resulting in park-like conditions of relatively open grown trees, or, in severe instances, produced open grass and shrub communities that required long time periods for conifer re-establishment.

The shady and cooler aspects at higher elevations characterize fire dynamics where moisture is usually more abundant. Fire return intervals range from frequent (less than 50 years) to infrequent (between 50 and 100 years). Fuel loadings are greater than those in VRU 3, with deeper and more continuous fuel beds. In the absence of fire, succession ultimately results in continuous vertical fuel ladders that are prone to lethal fire events. The fuel beds below the dense overstory respond slower to seasonal drying, but are capable of reaching higher intensities than those in VRU 3. Fire intensities are dictated by the fire return interval, vegetative successional stage, and structure in conjunction with fuel loadings, arrangement, continuity, and availability. Drought conditions also play a large role in this VRU by creating low fuel moistures setting the stage for a stand replacing or lethal event.

**Pre-fire conditions in VRU 4.** Same as VRU 3. Diversity of understory species often decreases in this VRU, with beargrass *(Xerophyllum tenax)*, grouse whortleberry *(Vaccinium scoparium)*, and blue huckleberry often dominating. Other species associated with this VRU are menziesia *(Menziesia ferruginea)*, coiled-beak lousewort *(Pedicularis contorta)*, leafy lousewort *(P. racemosa)*, Prince's pine *(Chimaphila umbellata)*, mountain arnica *(Arnica latifolia)*, and northwestern sedge *(Carex concinnoides)*.

#### *4.5.3.6 VRU 5: Cold, Moist, Upper Subalpine and Timberline Habitat Types*

On these high-elevation slopes and ridges, stands range from nearly pure lodgepole pine to mixed subalpine fir, lodgepole pine, and whitebark pine. Douglas-fir may be a minor component at lower elevations.

**Historic conditions in VRU 5.** Climate and soil factors are the primary successional influence on these upper subalpine and timberline habitat types. These ecological factors naturally create conditions for infrequent fires with an extended fire return interval of 35 to 300 plus years.

Fire dynamics are characterized by the cold and moist upper elevations where fuels are relatively sparse and discontinuous when compared to other VRUs. Fire return intervals are extended to 300 plus years and fire intensities are

typically restricted to creeping and smoldering events. The most pronounced fire effects are infrequent lethal fires occurring: (1) only in the continuous forest of this VRU; or (2) a wind or column dominated event originating from a VRU below and burning into or through this VRU. Fire intensities are more a function of the climate and soils rather than the vegetation.

The vegetation transitions that occurred within this VRU over time have not been as substantial as those in VRU 1 and 2. The current composition has greater similarity to the native system because this VRU has not had an extensive history of timber management, fire suppression efforts have been less efficient, and successional change is slower. The productivity of this VRU is low suggesting that the rate of change would be lower than the other VRUs described (Quigley et al., 1997). However, as slow as this change is, the composition of shade-tolerant species has increased as have tree densities, fuel loadings, and fire severity (Quigley et al., 1997). Fire exclusion and white pine blister rust have caused a real decline of communities dominated by whitebark pine (Quigley et al., 1997).

Native forests in this VRU generally maintained a fairly high composition of the late-seral multi-layer structure, typically in cold, wet bottoms or basins where fires rarely burned, or burned in a patchy, low-intensity gap mosaic pattern. The late-seral single-layer structure was typically maintained by underburning fires on benches and ridges that were dominated by whitebark pine and lodgepole pine. On occasion, fires reburned within a short period of time, producing open grass and shrub structures that could persist for relatively long periods before regenerating into forests again. Tree mortality from stress, insects, and disease generally thinned the communities and accelerated the growth of surviving trees (Quigley et al., 1997).

**Pre-fire conditions in VRU 5.** Very little past human activities have been accomplished here, however fire suppression and the effects of no fires have left this VRU in a slightly changed condition. Density is increasing, and the whitebark pine component is believed to be decreasing due to blister rust and the absence of fire.

Understory species can be similar to the subalpine VRU. Other species that may occur in this VRU include Hitchcock' woodrush *(Luzula hitchcockii)*, Labrador tea *(Ledum glandulosum)*, mountain heath *(Phyllodoce empetriformis)*, Ross sedge *(Carex rossii)*, and Tweedy's snowlover (*Chionophila tweedyii*). Noxious weeds are highly unlikely at this elevation.

### *4.5.3.7 Stand Structure*

**Historic stand structures.** The following table displays the distribution of age/size classes estimated to have existed in the Bitterroot Valley around 1900. This data is from Losensky's report on historical vegetation by climatic area (Losensky, 1993).

***Table 5-1. Historic stand structure distribution***

| Size/age class | Percent |
|---|---|
| Non-stocked | 9.1 |
| Seedling/sapling (1-40 years) | 22.7 |
| Pole (41-60 years) | 8.0 |
| Immature (61-100 years) | 19.9 |
| Mature (101-140 years) | 18.4 |
| Old forest (141+ years) | 21.9 |

**Pre-fire stand structure conditions.** Pre-fire vegetation conditions may be described by looking at the distribution of seral stages and structural components. These conditions are most strongly influenced by fire history and the degree of fire exclusion. Biological processes such as insects, diseases, and decay also play a role.

Table 5-2 shows pre-fire stand size class on Bitterroot National Forest lands in each analysis area.

***Table 5-2. Pre-fire stand structure distribution (percentage) by analysis area***

| Size class | Canyon/ Blodgett/ Mill/ Sheafman | East Fork Bitterroot | Skalkaho/ Rye/ Sleeping Child | West Fork Bitterroot |
|---|---|---|---|---|
| Non-stocked | 1.3 | 0.80 | 3.5 | 0.9 |
| Shrub | 1.4 | 0.01 | 0.1 | 0.1 |
| Seed/sapling | 4.7 | 6.0 | 12.3 | 5.8 |
| Pole | 27.6 | 8.9 | 26.3 | 22.4 |
| Immature/Mature | 58.0 | 82.3 | 55.0 | 63.5 |

Unfortunately the Bitterroot National Forest does not have an old forest or old growth analysis completed for the entire Forest. This does not allow us to compare the percentage of those acres with historic structures. Using 40% of the mature size class acres (as estimated by forest wildlife biologists), we can reasonable estimate the percentage of old forest stands in each analysis area. This would give us 23% for the Canyon/ Blodgett/ Mill/ Sheafman area, 34% for the East Fork, 22% for the Skalkaho/ Rye/ Sleeping Child area, and 25% for the West Fork analysis area. These percentages of old forest stand structures are higher than the historic percentage, but within the range expected historically.

Pre-fire structure distributions differ from historic conditions. Fewer seedling/ sapling conditions exist, while the percentage of pole and mature forests has increased. The large percentage of pole size class in Skalkaho/Rye/Sleeping Child is largely due to the Sleeping Child fire in 1961. This area's percentage of seedling/sapling size class is fairly high due to inclusion of Darby Lumber lands acquired by the Forest Service.

One important feature that differs from historic conditions is the amount of mature size class and lack of diversity in the other age classes. The data for the Bitterroot combines the immature and mature stands. This is because the majority of our stands falling out as immature in terms of size in diameter are actually over 100 years of age. The data for the pole size class can also be found to be mature in terms of age, but still of smaller diameters. Therefore, the Bitterroot has an abundance of age/size classes well over 100 years of age that includes the pole, immature, and mature size classes.

The following table displays stand structure by VRU. Structural diversity is an important factor in the characteristic of each VRU and another measure of how the landscape has changed since the beginning of fire suppression.

***Table 5-3. Pre-fire stand structure distribution (percentage) by VRU***

| Analysis area | Size Class | VRU 2 | VRU 3 | VRU 4 | VRU 5 | % High/Mod Severity | % Low Severity |
|---|---|---|---|---|---|---|---|
| Canyon/ Mill/Blodgett/ Sheafman | Shrub | 1.4 | 1.4 | 2 | 0.9 | 0 | 0.1 |
| | Seed/sapling | 6 | 0.9 | 3 | 15 | 2 | 0.6 |
| | Pole | 1 | 44 | 29 | 56 | 6 | 3 |
| | Immature/Mature | 85 | 54 | 59 | 24 | 10 | 9 |
| East Fork | Shrub | 0 | 0 | 0 | 0 | 0 | 0 |
| | Seed/sapling | 16 | 17 | 18 | 9 | 3 | 3 |
| | Pole | 5 | 11 | 11 | 4 | 2 | 2 |
| | Immature/Mature | 72 | 70 | 70 | 77 | 17 | 16 |
| Skalkaho/Rye Sleeping Child | Shrub | 0.6 | 0 | 0 | 0 | 0 | 0 |
| | Seed/sapling | 7 | 14 | 17 | 8 | 3 | 3 |
| | Pole | 19 | 18 | 37 | 37 | 6 | 8 |
| | Immature/Mature | 65 | 63 | 43 | 49 | 17 | 14 |
| West Fork | Shrub | 0 | 0 | 0 | 0 | 0 | 0 |
| | Seed/sapling | 10 | 6 | 5 | 0.5 | 0.3 | 0.3 |
| | Pole | 10 | 19 | 30 | 29 | 3 | 3 |
| | Immature/Mature | 67 | 69 | 57 | 61 | 7 | 8 |

As reflected in this table, there is some diversity found in some VRUs by analysis area, but generally the amount of pole, immature, and mature size classes leave little diversity in the younger size classes. The consequences of having a landscape lacking diversity and dominated by older and larger size classes will be addressed in later sections.

### *4.5.3.8 Past Management Activities*

Past logging practices have been part of this landscape for at least a century now. Old skid trails are evident and stumps can still be found throughout the area. Logging since the 1960s has generally been concentrated on the southerly and westerly faces less than 6000 feet elevation. The most rugged terrain and the roadless areas have not experienced the effects of logging; fire absence is the primary.

Although there are not actual acres and percentages of the amount of past regeneration, intermediate harvests, and prescribed fire available for the entire analysis area; the stand structures do reflect some of the past management (human caused) and past fire activities (lightning caused). There has been a lot of past harvesting done in the past, however the amount has not created the diversity in terms of age/size class distribution had we allowed fire to play its natural role in the ecosystem.

### *4.5.3.9 Historic and Past Forest Fires*

The following table describes the historic fires as mapped using historical photos and data by VRU. This information is important to help us understand how past fires have influenced and shaped the pre-fire stand structures.

***Table 5-4. Historic and Past Fires by VRU Acres***

| Decade | VRU 1 | VRU 2 | VRU 3 | VRU 4 | VRU 5 | Total |
|---|---|---|---|---|---|---|
| 1870 | 0 | 596 | 676 | 791 | 42 | 2,105 |
| 1880 | 70 | 16,976 | 24,782 | 47,305 | 9,148 | 98,281 |
| 1890 | 0 | 117 | 693 | 732 | 762 | 2,304 |
| 1900 | 0 | 1,818 | 2,163 | 5,810 | 1,471 | 11,261 |
| 1910 | 493 | 6,798 | 6,590 | 22,599 | 4,164 | 40,644 |
| 1920 | 0 | 1,662 | 2,218 | 2,443 | 190 | 6,513 |
| 1930 | 15 | 189 | 3,486 | 805 | 71 | 4,566 |
| 1940 | 0 | 1,482 | 1,958 | 1,195 | 320 | 4,955 |
| 1960 | 51 | 6,079 | 8,432 | 28,265 | 855 | 43,682 |
| 1970 | 0 | 893 | 1,273 | 490 | 77 | 2,733 |
| 1980 | 0 | 821 | 1,234 | 2,143 | 653 | 5,121 |
| 1990 | 10 | 2,006 | 4,928 | 7,175 | 1,760 | 15,879 |
| Total | 640 | 39,435 | 58,433 | 119,754 | 19,512 | 237,774 |
| Percent | 6.89 | 34.08 | 36.07 | 48.38 | 54.15 | 29.74 |

The key item to notice is how small a percentage of VRU 1 and VRU 2 have burned. Under a natural fire regime, these VRUs would have likely had 100% of the acres burned since 1870. The 7% for VRU 1 and 34% for VRU 2 explains the lack of fire in these ecosystems and why stand structures and health has been altered significantly.

### *4.5.3.10 Forest Health*

Forest health can mean many things to many people, particularly now after the fires of 2000. On one side, these fires were blamed on unhealthy forests. On the other side, people believe the fires have improved forest health.

For this discussion, forest health will be described in terms of susceptibility and resiliency to insects and disease, vigor and ability to overcome being drought and/or fire stressed, and sustaining biodiversity. This forest health discussion will also focus attention on the prevention of ecologically and/or socially undesirable forest conditions by integrating the various concerns of protecting the forest from future disturbances (such as insects, diseases, and wildfire) in an ecological framework as well as the restoration of ecologically and socially desired forest conditions.

Disturbances such as insects, disease, drought, and fire are all natural disturbances. This discussion will focus on when and where these disturbances are not natural and cause declines in forest health that are not ecologically desirable. This discussion will also focus on the declines in forest health that are not socially desirable.

The VRU section above explains historic insect and disease conditions. Pre-fire conditions are described below. Unfortunately, the most current information is from 1999; aerial observations were not made in 2000 because aircraft was needed for fire suppression efforts.

**White pine blister rust.** This exotic fungus was accidentally introduced into western North America from Europe around 1910. White pine blister rust can severely damage cone production capability, and whitebark pine regeneration is currently limited by lack of available seed. This disease is at epidemic proportions in the Bitterroot's whitebark pine zone (VRU 5), though the decline of whitebark pine populations has not been extensively monitored. Research in northern Rocky Mountain ecosystems has shown that whitebark pine is functionally extinct in more than a third of its range (Kendall, 2000). In the Greater Glacier Ecosystem in northwest Montana and southwest Alberta, dramatic declines in whitebark pine can be traced to white pine blister rust and fire exclusion.

Reintroduction of fire into the higher elevations is currently viewed as the best large-scale approach to recovery of whitebark pine. The Forest has used prescribed and natural fires in these areas.

**Dwarf mistletoe.** Dwarf mistletoe is a parasite of Douglas-fir, lodgepole pine, and western larch. The Forest mapped known and suspected infections in 1993 using the timber stand database, aerial photos, and the knowledge of experienced field personnel. Forest personnel spot-verified the resulting maps and determined them to be reliable. The 1993 map is the most recent available, but since dwarf mistletoe moves slowly it is

probably still reasonably accurate. Wildfires, prescribed fires, timber harvest, and timber stand improvement projects have also helped keep infection levels in check.

Table 5-5 describes the extent of the mistletoe infection of the Bitterroot's major host species in terms of infection severity. Severity levels are defined as follows:

*Low severity:* The mistletoe parasite is present in the stand, but most trees are not visibly infected.

*Moderate severity:* Visible mistletoe infections are common in the stand. Less than half the trees have obvious infections. Crowns of the infected trees are less than half affected.

*High severity:* More than half of the trees are obviously infected with mistletoe. More than half the crown is affected on a substantial number of trees.

***Table 5-5. Acres of dwarf mistletoe infection by severity (1993 data)***

| Host | Low | Moderate | High | Total |
|---|---|---|---|---|
| Douglas-fir | 114,906 | 74,044 | 131,493 | 320,443 |
| Lodgepole pine | 121,687 | 319,094 | 110,125 | 550,906 |

**Pine needle cast.** The most obvious disease pathogen on the Bitterroot National Forest in 1998 was pine needle cast. In ponderosa pine, the cause of this disease is *Elytroderma deformans,* while in lodgepole pine it is *Lophodermella concolor.* In 1999 and 2000, surveys found only *Elytroderma*-infected trees. Elytroderma is not known to kill trees directly, but it does weaken infected trees and cause loss of vigor. Weakened trees are susceptible to attack by bark beetles. Trees that have been infected for several successive years display obvious witch's brooms, matted clumps of needles and branches that usually droop downward.

A 1998 aerial survey found 175 acres of needle cast. Both varieties of needle cast actually occurred much more broadly on the Forest in 1998, affecting probably 50,000 to 75,000 acres. The aerial survey in 1999 reported no infected acres. Regardless of aerial survey results, elytroderma seems to be very prevalent, particularly from Darby south along the Bitterroot River. Many acres of private land also are infected to various degrees.

*Elytroderma* infection usually occurs in cool drainages and dense stands of trees and on the edges of riparian areas and wide draws. Fire suppression during the last century has led to more densely stocked stands, which are more susceptible to this disease (USDA Forest Service, no date).

**Western spruce budworm.** No spruce budworm infestations on the Bitterroot NF were observed in 2000. No visible defoliation from aerial surveys has been detected in the region since 1993. Spruce budworm populations are cyclic and are increasing in several parts of the region with some defoliation detected during the aerial survey in 2000. The Bitterroot NF has many areas that have had historical outbreaks of spruce budworm.

Populations of budworm are expected to increase across the region according to history and current insect population trends.

**Mountain pine beetle.** Scattered sightings of beetle-killed ponderosa pine and, to a lesser degree, lodgepole pine, continue to be recorded throughout pine forest types on the Bitterroot National Forest. These kills may provide a seed population that could build into major infestations under favorable climatic conditions, such as a series of dry summers. Very dry summers could result in beetle populations in young ponderosa pine stands, similar to those seen during the 1986 to 1989 drought.

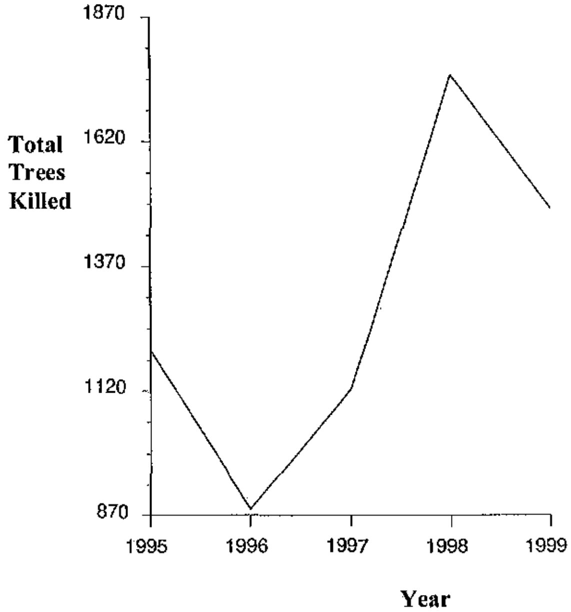
Ponderosa pine stands infested with mountain pine beetles in 1999 on the Bitterroot National Forest totaled 1,085 acres, and lodgepole pine mortality occurred on 36 acres (Table 5-6). Including state and private lands, ponderosa pine and lodgepole pine infestations within the Bitterroot Valley totaled 2,003. This is an 11 percent increase from 1998 levels. In 1999 increased ponderosa pine mortality caused by beetles was observed in and adjacent to wildfires and prescribed burns.

***Table 5-6. Mountain pine beetle infestation levels by host species & ownership, 1995-1999***

| | | 1995 | | 1996 | | 1997 | | 1998 | | 1999 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ownership** | **Species*** | **Acres** | **Dead Trees** | **Acres** | **Dead Trees** | **Acres** | **Dead Trees** | **Acres** | **Dead Trees** | **Acres** | **Dead Trees** |
| National Forest | PP | 366 | 1,120 | 497 | 720 | 469 | 1,098 | 35 | 33 | 1,085 | 1,464 |
| | LP | 37 | 61 | 79 | 246 | 18 | 26 | 1,726 | 1,721 | 36 | 72 |
| State lands | PP | 131 | 348 | 113 | 234 | 1,194 | 1,811 | 0 | 0 | 664 | 850 |
| | LP | 8 | 45 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | 0 |
| Private lands | PP | 297 | 961 | 218 | 358 | 634 | 1,223 | 46 | 46 | 218 | 273 |
| | LP | 6 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | PP | 794 | 2,429 | 828 | 1,312 | 2,297 | 4,132 | 81 | 79 | 1,967 | 2,587 |
| | LP | 51 | 129 | 79 | 246 | 18 | 26 | 1,728 | 1,726 | 36 | 72 |

* PP - ponderosa pine, LP - lodgepole pine

***Figure 5-1. Number of trees killed by mountain pine beetle, 1995-1999***




**Other pine bark beetles.** Western pine beetles and pine engraver beetles were reported on fairly limited acreage in 1999, as shown in Table 5.7. The aerial survey map did not show any pockets of mortality caused by either of these species. The attack areas were difficult to detect from the air since they were generally no more than an acre in size and included only a few dead or dying trees. It appears these beetle attacks were only mild and widely scattered across the Bitterroot National Forest before the fires of 2000.

**Douglas-fir bark beetle.** Populations of Douglas-fir bark beetles (DFB) remained static from 1993 to 1998, and no large outbreaks occurred. In 1998 aerial surveys indicated a sharp jump in Douglas-fir mortality caused by DFB. Populations reached epidemic proportions on the south half of the Forest (Sula and West Fork Ranger Districts) in 1999. The abundance of mature Douglas-fir, presence of root disease, widely scattered groups of beetle kill, and the size of beetle-infested groups of trees suggest that beetle populations could remain high in this area. See Map 5-3 in Appendix B for spatial display of the DFB populations for the last five years.

DFB caused the death of approximately 11,287 trees on 9,511 acres in 1998. This was a sharp jump from the 1994 to 1997 levels, during which about 100 acres were affected each year. In 1999 the mortality jumped again to over 60,000 trees on approximately 13,500 acres (see Figure 5-2). These numbers are probably low since the detection flight took place before some of the mortality from the 1998 attacks would have been evident. There are probably more than 20,000 acres of infected trees on the Forest. The majority of this mortality is concentrated in the Selway-Bitterroot and Frank Church-River of No Return wilderness areas, with stringers of beetle populations in Beaver, Deer, Hughes, Overwhich, and Slate Creeks in the upper West Fork drainage. DFB has also caused

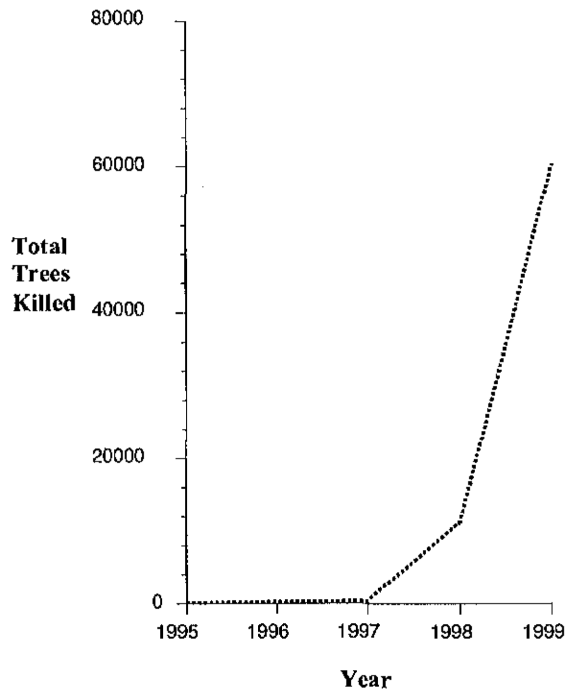
heavy mortality in the upper East Fork, along the road corridor on both north and south slopes between Tolan and Martin Creeks.

The cause of this epidemic is probably a combination of 1995 blowdown, weather patterns (early, warm, dry springs and late, hot, dry falls), and root rot infections. Another key factor is the last 50 years of fire suppression, which has reduced age/size class diversity. Mature Douglas-fir stands dominated by trees 14 inches in diameter or larger are very common, and are especially susceptible to DFB.

At low population levels, DFB thrives in large diameter down trees and is not particularly aggressive. When populations increase, the beetles attack standing live trees that are also large-diameter, old, and showing signs of stress. This stress could be a result of root rot, old age, or competition for sunlight, water, and nutrients. Elevated or epidemic DFB populations usually occur in a four-year cycle. The year 2000 would be the fifth year of this event, however monitoring before the fires began indicated a decline in populations.

Wildfires and prescribed fires may also be contributing to the epidemic. There seems to be a positive correlation between fire (either natural or prescribed) and DFB populations. This is probably a result of beetles taking advantage of fire-stressed trees. Within the wilderness areas in 1999, tree mortality caused by this interaction was greater than expected due to the large beetle populations currently active on the south half of the Forest. Beetle mortality has been observed to form a "halo" around most fires that burned in the last 2 years in the Douglas-fir zone, so one effect of the fires of 2000 may be that the current DFB epidemic lasts longer than the usual four-year period.

Figure 5-2. Number of trees killed by Douglas-fir bark beetle, 1995-1999




**Root disease.** Root diseases have increased considerably in the last year, as shown by the 1999 aerial detection surveys. Incidence of root rot ranged from 10 to 110 acres per year in the 1996-1998 period, but was close to 700 acres in 1999. The majority of these infections are located in the Selway-Bitterroot and Frank Church-River of No Return wilderness areas. Root disease predisposes Douglas-fir to DFB attack. Management activities do not appear to be encouraging root disease. Past fire suppression may, however, have contributed to the current levels of root rot, since stands that might otherwise have burned (those with late seral species, high density, and older trees) are more susceptible to root diseases.

Though root diseases may not be readily apparent in many stands, its presence should be suspected. Root diseases are common in Douglas-fir and mixed-species stands (VRUs 3 and 4) in this part of the Douglas-fir range **(Figure 5-7, Appendix A).** Aerial detection surveys tend to see and account for root rot pockets or centers that are quite visible rather than the ones that occur sporadically both in time and space. Many more areas infected with root rot exist across the Forest and have been detected by field personnel but are not causing much damage at this time.

**Western balsam bark beetle.** Aerial surveys also observed western balsam bark beetle (WBB) in 1998 and 1999. Although the exact relationship between WBB and DFB is not yet known, field observations have determined that many of the WBB infestations occur in the same vicinity as DFB but in the higher elevation spruce and subalpine forests

(VRU 4). An example of this is in the Hughes Creek drainage along Taylor Creek, where DFB and WBB are present on the same aspect.

A cursory examination of the WBB pockets shows no previous harvest activity, roads, prescribed fire, or wildfire within the vicinity. As with the DFB, WBB populations have probably increased due to the abundance of large diameter, older subalpine fir stands that may be showing signs of stress from overstocking, old age, or undetected root rot.

***Table 5-7. Insect & disease aerial survey summary, 1999***

| Pathogen | National Forest | | Private Land | | State Land | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Acres | Trees* | Acres | Trees* | Acres | Trees* | Acres | Trees* |
| Douglas-fir beetle | 13,574 | 60,486 | 31 | 139 | 26 | 115 | 13,631 | 60,740 |
| Western pine beetle | 99 | 52 | 38 | 20 | 14 | 8 | 151 | 80 |
| Pine engraver beetle | 2 | 5 | 2 | 5 | 2 | 5 | 6 | 15 |
| Western balsam bark beetle | 167 | 472 | 0 | 0 | 0 | 0 | 167 | 472 |
| Root rot | 691 | | 0 | 0 | 0 | 0 | 691 | |
| Western larch needle disease | 0 | 0 | 11 | | 0 | 0 | 11 | |
| Tent caterpillar | 0 | 0 | 46 | | 0 | 0 | 46 | |
| Total acres | 20,728 | | 176 | | 73 | | 20,977 | |

*Affected trees were not counted for all categories.

**In summary.** When insects and diseases are on the rise, such as during a Douglas-fir beetle outbreak, the problem isn't simply the beetles. The real problem is the underlying factors causing the rise in beetle population. The main factors are vegetation structure, composition, and age, usually at a landscape scale. Elevated populations of Douglas-fir beetle and other insects and diseases (except mountain pine beetle) is not "natural", but rather an effect of the substantial decrease in structural and age class diversity that has taken place at the landscape scale and the increased stand densities. The absence of fire has allowed these changes to take place. These conditions support and hold potentially large insect and disease populations. Insect and disease infestations are symptoms that vegetative conditions are not within natural regimes.

### *4.5.3.11 Sensitive Plants*

**VRU 2.** The West Fork Ranger District is known for its diversity of plant life including having the most different sensitive plant species on the Bitterroot National Forest. Most of these occur in this VRU and include hollyleaf clover *(Trifolium gymnocarpon),* Rocky Mountain paintbrush (*Castilleja covilleana*), Lemhi penstemon (*Penstemon lemhiensis*), Payette penstemon (*P. payettensis*), and dwarf onion (*Allium parvum*). Populations of northern golden-carpet *(Chrysosplenium tetrandrum)*, a species of special concern on the Forest, also occur in the tributaries of the West Fork of the Bitterroot River. Northern

golden-carpet grows on moss-covered rocks, logs in streams, along stream banks, and in seeps.

Even with the large number of sensitive plant populations in the West Fork area, none of the known populations in this VRU were impacted by these fires. However, there is sensitive plant habitat that received moderate to high severity burn. Chicken and West Creeks were never surveyed for sensitive plant populations prior to the fire, and it is possible that hollyleaf clover exists in some of the burned areas. This clover is only known from the area around Painted Rocks Lake, although populations have been found as far south as Coal Creek. Hollyleaf clover has a deep taproot making it well adapted to withstand low to moderate fire severities (Volland and Dell, 1981). A high severity burn would be more likely to kill the root crown, but some plants would probably survive and seed may be still be viable if buried in the soil.

The major threat to the sensitive plants and sensitive plant habitat in this VRU is the possibility of knapweed encroachment into areas where canopy cover has been lost due to tree mortality.

Riparian areas where northern golden-carpet occurs did not burn in the burned areas of the West Fork drainage.

**VRU 3.** Some of the same sensitive plant species as mentioned in VRU 2 likely spill over into this VRU. Hollyleaf clover is often found in Douglas-fir habitats associated with pinegrass. As mentioned in VRU 2, hollyleaf clover would likely resprout following fire or germinate from seeds in the soil.

**VRU 4.** Populations of candystick (*Allotropa virgata*) are known to occur in this VRU in the upper Mine Creek and upper Buck Creek drainages. Candystick occurs in mature lodgepole pine stands associated with beargrass and grouse whortleberry. The upper reaches of Chicken, West and Slate Creeks contain potentially suitable habitat but have never been surveyed for candystick.

Candystick is a mycotrophic species, obtaining carbohydrates from a mycorrhizal fungus associated with its roots. The mycorrhizae are usually associated with lodgepole pine or some other subalpine conifer species in the northern Rockies populations. Harvesting trees in candystick habitat is one immediate threat to this species. However, the dominant threat to candystick is thought to be years of fire suppression resulting in a greater likelihood of large stand replacing fires in areas that may have had more of a mosaic burn pattern in the past (Lichthardt, 1995). These large, stand-replacing fires essentially destroy candystick habitat. It will take up to 100 years for these sites to recover to a point where candystick colonization will recur. Since it was unknown if candystick existed in the high burn severity areas of this VRU we may not know if candystick ever did exist there for many years.

The ecology of candystick is still not well understood since it is unknown when conditions will become appropriate for candystick seed, mycorrhizae, and conifer root to unite.

**VRU 5.** There are no known populations of sensitive plants in this VRU in the burned areas of the West Fork drainage. Candystick is sometimes found associated with whitebark pine.

### *4.5.3.12 Forestland Integrity*

The Interior Columbia Basin Ecosystem Management Project (ICBEMP) suggests managing forested stands at a landscape or watershed scale that exhibit high forestland integrity (Quigley et al., 1997). The elements of high integrity include: providing consistent tree stocking levels that are typical for the forest vegetation present, limiting the amount and distribution of exotic species, increasing and or creating snags and down woody material, reintroduce fire and mimic its effect on the composition and patterns of forest types, and to maintain the historical fire severity and frequency regimes.

The ICBEMP characterized vegetation conditions (pre-fire) and trends as compared to historical conditions (early 1800s) and include some of the following:

- There has been a 27% decline in multi-layer and 60% decline in single-layer old-forest structures from historical levels which is predominately lost in ponderosa pine and Douglas-fir forest types.

- The threat of severe lethal fires has increased by nearly 20%, predominately in the dry and moist forest types. Fire frequency has generally decreased over the last 200 years. Very frequent and frequent fire regime intervals have declined by approximately 32%, which is largely due to effective fire prevention and suppression strategies, selection and regeneration cutting, livestock grazing, and introduction of exotic plants. Comparing fire severity between historic and current times shows an increase in lethal fire from 20 - 50% of the area and a reduction in non-lethal fires from 40 to 15%.

- Area and connectivity of early-seral forests declined particularly where historical fire regimes were predominantly mixed severity or lethal. These structures have been replaced to a substantial degree with mid-seral structures.

- Intermediate-aged forest increased dramatically in area and connectivity, as did the volume of timber in small-diameter classes.

- Affected by fire exclusion, selective harvesting and grazing, forests have expanded into areas of historical grassland, woodland, and shrubland. The forest canopies also became more complex and layered.

- Fire severity generally shifted from non-lethal and mixed severity to lethal regimes due to fire suppression and longer intervals between fires.

- Forests have become more densely stocked, developed increasing dominance of shade-tolerant species, and have become more susceptible to severe fire, insect, and pathogen disturbances.

- Forest composition and structures have largely become more homogeneous creating homogenous-forested landscapes. Altered fire regimes have been largely responsible for more homogeneous forest landscapes as well.

ICBEMP also states that the continuation of managing vegetation (commercial harvest, precommercial thinning, and prescribed burns) at past/current levels and managing individual stands is unlikely to reverse trends in vegetation conditions described above. This is because in the last 100 years, wildfire severity and intensity has doubled; insect, disease and fire susceptibility have increased by 60%, blister rust has decreased whitebark pine in moist and cold forested vegetation types, native grasslands have decreased by 70%; native shrublands have decreased by 30%; large residual trees and snags have decreased by 20%; and, old forest structures have decreased 27 - 60% depending on vegetation type. The greatest changes in landscape patterns and processes, according to the ICBEMP, have been in roaded areas historically managed with intensive treatments (Quigley et al., 1997).

## 4.5.4 Effects and Implications of the Fires of 2000: Bitterroot River Drainage

### *4.5.4.1 Effects on VRU 2*

A large percentage of this VRU was burned in the fires of 2000, including portions of private land. With the wind events experienced, particularly on August 6, 2000, this VRU experienced a wide range of fire intensities. Unlike the historic fire regime where a low intensity or non-lethal burn would be expected, the fires of 2000 created a more continuous mosaic of high, moderate, and low intensity burns. In summary, this VRU burned with greater intensities than the historic regime due to the conditions described above **(Figure 5-4, Appendix A)**.

The severity mapping for the BAER (Burned Area Emergency Rehabilitation) analysis addresses the effects on soil. All of the high severity areas mapped are lethal or stand-replacing events, however some of the moderate severity areas were also lethal. The result of these lethal events is significant due to the lack of seed source to provide natural regeneration. The size of these areas is also critical due to the lack of seed wall in the vicinity. Natural regeneration will be sparse and take an extremely long time to occur in these areas. In the Bitterroot, there has not been a good cone crop for ponderosa

pine in last 12 years. This year we experienced a fair cone crop that should be quite beneficial in natural regeneration in those areas of mixed severity and low intensity fires, and in those areas where there is an adequate seed wall adjacent to the lethal areas.

Some of the large diameter "yellow" barked ponderosa pine did survive the low and mixed severity fires. Unfortunately, the majority of these individuals show signs of being past their seed bearing age. These individuals can still produce some cones, however the seed inside is often not viable.

Trying to maintain or enhance ponderosa pine in this VRU may be problematic and will require interplanting or full planting depending on the intensity of the fire. Due to the fire intensity, the historic structure and function of these habitats in this VRU have been significantly altered.

Understory vegetation, from our initial surveys, indicates that it has survived even in the most intense fire areas. Sprouting has already begun for many species, and under ground surveys indicates live root and shoots. Scouler willow and Wood's rose were seen sprouting even in high severity burn areas on the Valley Complex. In addition, thimbleberry, Rocky Mountain maple, ninebark, and Oregon grape were seen sprouting in moderate to high severity burn areas. Typically, fires are very beneficial to native species. Shrub species are usually top killed by fire and resprout from root crowns or underground plant parts due to the release of growth hormones (Noste and Bushey 1987). Old and decadent shrubs are top killed and forced to resprout creating a situation where they can increase their ground coverage. Surveys indicate the fires of 2000, regardless of intensity, are beneficial for native understory species. However, this is complicated by the presence of noxious weeds, particularly spotted knapweed that takes advantage of disturbed areas.

As mentioned above, spotted knapweed is a major component in the plant communities on many south-facing slopes in the Bitterroot National Forest. In moderate to high severity burn areas there is likely to be a large degree of canopy loss, increasing the risk of knapweed encroachment on these sites if a seed source is nearby (Losensky, 1987). Severely burned areas have the added risk of soil disturbance due to the loss of duff and litter.

The distinction between the severity mapped for soils and intensity for overstory vegetation is important for two reasons when considering the invasion potential of noxious weeds. The high severity areas are areas where intense soil disturbance has been noted and usually were lethal to 90 – 100% of the trees. Moderate severities are areas where there is a canopy reduction, near 100%, however needles and cones were not entirely consumed but very little to no live crown remains. These two factors create an unprecedented situation for noxious weed invasion on sites not previously having populations present or where populations have been low due to the canopy closure.

VRU 2 frames the wildland/urban interface on the Bitterroot National Forest. As seen in 2000, slope is a large factor in fires moving up or down the landscape into or out of the interface. This creates a fuels concern for not just the interface, but for the landscapes above the interface. Many of these stands that did not receive fire in 2000 are still predisposed to high intensity, lethal, stand-replacement events where threat to life/property and social/political consequences are extremely high.

The values at risk and the risk of a wind-driven fire event moving from this VRU down into the interface is extremely high and must be given significant consideration. This VRU is also very visible on both sides of the valley to the local communities resulting in yet another perceived threat.

### *4.5.4.2 Effects on VRU 3*

As with VRU 2, this VRU also experienced mixed fire intensities. The most obvious feature of the fire effects is where this VRU is present on north aspects on landscapes dominated by VRU 2 **(Figure 5-5, Appendix A)**. Many of these areas were lethal events or mixed severity. Because of the low elevation and proximity to VRU 2, these areas are of concern for noxious weed invasion. Once again, because of how the fire burned, there is a lack of seed source and lack of canopy where both were present before the fires.

On the remainder of this VRU, the fires of 2000 burned a mosaic pattern of stand-replacement, mixed severity, and low intensity burns. Across the landscape this typifies the historic fire regime and was quite beneficial in terms of structure and function of these systems.

There could be considerable secondary fire effects associated with this VRU due to the Douglas-fir bark beetle epidemic across much of the south half of the forest. Douglas-fir bark beetle is not attracted to fire killed dead trees, but is attracted to fire weakened trees associated with mixed severity and low intensity fires. Where this VRU is at low elevations or lies near VRU 2, this secondary fire effect will contribute greatly to the reduction on tree canopies and the potential for noxious weed invasion.

Shrub response should be similar to VRU 2, although there is more high severity burn area. Shrub recovery is still expected to occur and pinegrass sprouting was already observed on certain north-facing aspects. The fine roots of pinegrass were seen in the soil indicating a high likelihood of regeneration.

### *4.5.4.3 Effects on VRU 4*

Generally, the fires of 2000 burned lethal or mixed severity in this VRU **(Figure 5-6, Appendix A)**. Both types of fires are within the bounds of the historic fire regime. The benefits of breaking up the age and size class mosaic across the landscape within this VRU are substantial. For example, the Sleeping Child burn that occurred in 1961 acted as a fuel break for the fires of 2000. In addition, a landscape with age/size class diversity will be less susceptible to mountain pine beetle becoming epidemic, or that epidemic occurring for an extended period of time.

Because lodgepole pine is particularly adapted to stand replacing or lethal fires, natural regeneration should not be a concern.

Spotted knapweed populations may occur in this VRU, however they are usually concentrated around roads, trailheads, and other disturbed areas. Musk thistle (*Carduus nutans)* may also be found along roadsides, but is usually not a large threat in higher elevations. Noxious weed invasion into the lethal fire areas is not of concern. Beargrass regeneration is expected to be rapid and was observed on even the most severely burned areas in the Valley Complex. The regeneration of lodgepole pine will also aid in reducing any possible noxious weed invasions.

#### *4.5.4.4 Effects on VRU 5*

Generally the fires of 2000 burned mixed severity in this VRU, which is well within the historic fire regime. The concern for this VRU is where a lethal fire did not leave a seed source for whitebark pine. Because the populations of whitebark pine have been declining due to fire suppression and white pine blister rust, researchers are not sure of the effects of a stand-replacing event in areas where whitebark has been declining. Continued monitoring and research of this situation within a variety of fire intensities should continue.

Understory species respond similarly to subalpine species. Beargrass is expected to resprout even in the most severely burned areas due to the thick rhizomatous rootstock.

Table 5-8 displays the acres and percent of the analysis area by VRU. These acres only include National Forest lands. The acres reported in the "Not Classified" column are acres that could not be classified because they lack the necessary data (roadless areas, wilderness, and private lands). To summarize Table 5-8, the vegetated land area in the West Fork, East Fork, and Rye-Skalkaho analysis areas follows this general pattern:

- VRU 1 ranges from 0 to 3%
- VRU 2 ranges from 15-18%
- VRU 3 ranges from 16 – 28%
- VRU 4 ranges from 31 – 40%
- VRU 5 ranges from 3 – 7%

Because the majority of the Canyon/Blodgett/Mill/Sheafman analysis area is not classified, the acres and percentages in that analysis area do not adequately represent the actual VRU.

***Table 5-8. Burn acres by VRU and analysis area***

| Analysis Areas | VRU | 1 – Grasslands | 2 – Warm, Dry PP and DF | 3 – Cool, Dry, and Moist DF | 4 – Cool LP and Lower Subalpine | 5 – Cold, Moist, Upper Subalpine and Timberline | Not Classified |
|---|---|---|---|---|---|---|---|
| West Fork | Acres | 3 | 41,643 | 64,576 | 90,342 | 14,855 | 15,669 |
| | Percent | 0 | 18.34 | 28.44 | 39.78 | 6.54 | 6.8 |
| East Fork | Acres | 6,081 | 35,015 | 54,525 | 72,957 | 7,774 | 46,989 |
| | Percent | 2.72 | 15.68 | 24.41 | 32.67 | 3.48 | 21.04 |
| Canyon/Blodgett/ Mill/Sheafman | Acres | 0 | 1,877 | 3,185 | 8,166 | 4,619 | 87,748 |
| | Percent | 0 | 1.78 | 3.02 | 7.73 | 4.37 | 83.09 |
| Rye/Sleeping Child/Skalkaho | Acres | 210 | 37,179 | 39,712 | 76,053 | 8,783 | 81,502 |
| | Percent | .09 | 15.27 | 16.31 | 31.24 | 3.61 | 33.48 |
| Total Acres by VRU | | 9294 | 115,714 | 161,998 | 247,518 | 36,031 | 231,908 |

### *4.5.4.5 Fire Intensity*

Burn severity classes, as applied by BAER (Burned Area Emergency Rehabilitation), are based on the impacts of fire on soil and watershed function, such as increases in erosion and runoff potential. Burn severity is not the same thing as fire intensity, which is related to flame length, rate of spread, tree mortality, and other factors.

***Table 5-9. Burn severity by VRU and analysis area***

| Analysis area | Burn severity | VRU 1 | VRU 2 | VRU 3 | VRU 4 | VRU 5 | Not classi-fied | Totals by severity |
|---|---|---|---|---|---|---|---|---|
| West Fork | High | 0 | 1995 | 3560 | 9853 | 1086 | 418 | 16,912 |
| | Mod | 0 | 13363 | 1644 | 2686 | 547 | 508 | 18,748 |
| | Low | 2 | 4749 | 6635 | 11049 | 961 | 761 | 24,157 |
| | Total | 2 | 20,107 | 11,839 | 23,588 | 2,594 | 1,687 | 59,817 |
| East Fork | High | 698 | 6732 | 9387 | 8271 | 488 | 15988 | 41,564 |
| | Mod | 287 | 4294 | 4615 | 2733 | 578 | 9340 | 21,847 |
| | Low | 1597 | 10454 | 14226 | 12065 | 517 | 4281 | 43,140 |
| | Total | 2,582 | 21,480 | 28,228 | 23,069 | 1,583 | 29,609 | 106,551 |
| Canyon/ Blodgett/ Mill/ Sheafman | High | 0 | 436 | 568 | 1214 | 402 | 729 | 3349 |
| | Mod | 0 | 173 | 205 | 371 | 132 | 581 | 1462 |
| | Low | 0 | 320 | 631 | 1196 | 241 | 4247 | 6635 |
| | Total | 0 | 929 | 1404 | 2781 | 775 | 5557 | 11,446 |
| Rye/ Sleeping Child/ Skalkaho | High | 1 | 6492 | 4980 | 9222 | 369 | 3651 | 24,715 |
| | Mod | 0 | 5014 | 5189 | 9579 | 1578 | 7389 | 28,749 |
| | Low | 126 | 10598 | 9809 | 17504 | 1850 | 14173 | 54,060 |
| | Total | 127 | 22,104 | 19,978 | 36,305 | 3,797 | 25,213 | 107,524 |
| GRAND TOTAL | | 2,711 | 64,620 | 61,449 | 85,743 | 8,749 | 39,366 | 262,638 |

A high percentage of VRU 2 burned at either high or moderate severity, which were predominately stand replacing or lethal fire events. Because we know the historic fire regime in VRU 2 was predominately high frequency and low intensity fires, we would expect the largest percentage of acres burned to be in the low burn severity category under natural conditions. However, what we see is the opposite. Of the percentage of burned VRU 2 acres we find that 59% burned with a lethal fire event and 40% with a low severity fire. This is a key factor in understanding how current fire behavior and severity in VRU 2 significantly differs from the historic fire regime.

VRU 3 has a historic fire regime that was predominately mixed severity. In general, this is exactly how the fires of 2000 burned. The historic percentages of lethal, mixed, and low intensity is not precisely know, however we can estimate that fires generally burned fairly equally in each of these intensity classes. As shown in Table 5-10, approximately 48% of this VRU burned with a lethal fire event (high and moderate severity) and 50%in the low severity. This distribution does not reflect the acreages that may have burned mixed intensity, however it is likely to be reflected in the 50%of low severity. This tells us that the distribution of intensity classes were not equal, but were heavy toward the lethal fire events.

VRU 4 is known to burn with a historic fire regime of mixed and lethal intensities. Lethal fire events tend to be more common than mixed severity fires in VRU 4. Approximately 50% of the total acres of VRU 4 burned in either high or moderate severity in the fires of 2000. In terms of percentage of fire severity, VRU 4 burned similar to its historic fire regime. VRU 5 also burned very similar to its historic fire regime.

***Table 5-10. Burn severity by percentage of VRU***

| VRU | Burn Severity | Acres | % of VRU Acres | % of Burned VRU Acres | % of Burned Acres |
|---|---|---|---|---|---|
| VRU 1 – Grasslands | High | 699 | 7.52 | 25.78 | 0.27 |
| | Moderate | 287 | 3.01 | 10.59 | 0.11 |
| | Low | 1725 | 18.56 | 63.63 | 0.66 |
| | Total | 2711 | 29.17 | 100 | 1.03 |
| VRU 2 – Warm, Dry PP and DF | High | 15,655 | 13.53 | 24.23 | 5.96 |
| | Moderate | 22,844 | 19.74 | 35.35 | 8.70 |
| | Low | 26,121 | 22.57 | 40.42 | 9.95 |
| | Total | 64,620 | 55.84 | 100 | 24.60 |
| VRU 3 – Cool, Dry, and Moist DF | High | 18,495 | 11.42 | 30.01 | 7.04 |
| | Moderate | 11,653 | 7.19 | 18.96 | 4.44 |
| | Low | 31,301 | 19.32 | 50.93 | 11.92 |
| | Total | 61,449 | 37.93 | 100 | 23.40 |
| VRU 4 – Cool LP and Lower Subalpine | High | 28,560 | 11.54 | 33.31 | 10.87 |
| | Moderate | 15,369 | 6.21 | 17.92 | 5.85 |

| VRU | Burn Severity | Acres | % of VRU Acres | % of Burned VRU Acres | % of Burned Acres |
|---|---|---|---|---|---|
| | Low | 41,814 | 16.89 | 48.77 | 15.92 |
| | Total | 85,743 | 34.64 | 100 | 32.65 |
| VRU 5 – Cold, Moist, Upper Subalpine and Timberline | High | 2,345 | 6.51 | 26.80 | 0.89 |
| | Moderate | 2,835 | 7.87 | 32.40 | 1.08 |
| | Low | 3,569 | 9.91 | 40.79 | 1.36 |
| | Total | 8,749 | 24.28 | 100 | 3.33 |

### 4.5.4.6 *Effects on Stand Structure*

Post-fire stand structure data has not yet been collected. We can estimate stand structure changes by comparing pre-fire size class data to the BAER fire severity map. Assuming that both high and moderate severity burns killed all or most of the trees and that low severity had little effect on forest structures overall, the following generalizations can be made.

- Previous stands with non-stocked and shrub structures have not changed.
- Seedling/sapling structures burned at high and moderate severity have changed to non-stocked and will remain non-stocked for 10 to 15 years.
- Seedling/sapling structures burned at low severity have not changed.
- Pole and immature/mature structures have changed to non-stocked and will stay that way for the next 10 to 15 years, after which time they will transition to seedling/sapling.
- Pole and immature/mature structures burned at low severity have not changed.

Table 5-11 and Map 5-2 (Appendix B) summarize estimated post-fire stand structure by analysis area.

***Table 5-11. Estimated post-fire stand structure distribution (percent) by analysis area in 15 – 20 years***

| Size class | Canyon/ Blodgett/ Mill/ Sheafman | East Fork Bitterroot | Skalkaho/ Rye/ Sleeping Child | West Fork Bitterroot |
|---|---|---|---|---|
| Non-stocked | 1.3 | 1.1 | 4 | 1.0 |
| Shrub | 1.4 | 0.01 | 0.1 | 0.1 |
| Seed/sapling | 22 | 25 | 35 | 16 |
| Pole | 22 | 7 | 20 | 19 |
| Immature/Mature | 47 | 65 | 38 | 57 |

The question after the fires is whether or not size/age class structures at the landscape scale are beginning to approach the historic distribution. Although the amount of

seed/sapling does begin to approach the historic percentage expected, the pole and immature/mature size classes (with ages greater than 100 years) are still too high. More diversity is needed to create a true immature size class at ages 60 – 100 years of age and a pole size class at 40 – 60 years of age. The amount of old forest component that burned during the fires of 2000 is not known at this time, however surveys in the years to follow will answer this question.

### *4.5.4.7 Past Management Activities*

An issue raised internally and by the public is whether or not past management practices had an influence on the fire behaviors experienced in 2000. Current research is underway to evaluate this by investigating past harvest units and methods, prescribed fires, fuels treatments, etc. Throughout the burned area, there are examples of where past management did reduce fire intensity and influence the fire behavior by creating fuel breaks. However, there are also examples where past management did not change fire behavior and the end result was still a lethal fire event.

What we do know is that with extremely dry fuel moistures, drought, and wind; the behavior of these fires was unpredictable and unstoppable even in the most heavily managed areas. We also know there were a large number of factors (humidity, local winds, slope, etc.) influencing the day to day and hour to hour fire behavior that played a role in whether or not managed stands burned or didn't burn.

### *4.5.4.8 Post-fire Forest Health*

<u>Estimating primary fire effects on mortality</u>
Predicting whether conifers damaged by wildfire will live or die is not an exact science. This assessment uses the following mortality estimation guide, which was developed from several research sources. The key factors listed below determine the primary fire effects on mortality. Secondary fire effects such as insect attack are discussed later in this section.

1. ***Crown damage.*** With few exceptions, trees with less than 30 percent of their crowns undamaged by fire will die within 5 years. Exceptions can occur when buds on the tree remain alive.

2. ***Root damage.*** Conifers can be placed into two general rooting groups: deep-rooted, including western larch, Douglas-fir, and ponderosa pine; and shallow-rooted, which includes all other species. Deep-rooted species can withstand light ground fires of short duration, but major damage takes place when fine roots are exposed to long-lasting, extreme heat (generally caused by fuel build-up at the base of the tree). Root systems of the shallow-rooted species are susceptible to damage by light ground fires.

3. *Stem damage.* Observations of fire-scarred trees indicate that trees usually do not survive having over 50 percent of their circumference damaged. This mortality results from a combination of various types of damage caused directly or indirectly by fire, including destruction of cambium, decay, mechanical weakness, and predisposition to insects. Surprisingly, around 50 percent of ponderosa pine trees can incur large fire scars and damage to as much as half their circumference but still survive. Other species tend to be very sensitive to stem damage and mortality rates are around 75 percent. The amount of stem damage can be sampled by cutting through the bark into the cambium to determine if it is alive (milky white and moist) or dead (dry and discolored). Deep damage to the stem is characterized by bark that is deeply charred around the base and lower bole (but not necessarily to the wood) and bark that has lost its surface characteristics. Additional signs include loss of bark color within the deep fissures of older trees, portions of the bark burned off, large fuels burned at the base of the tree, and bole scorch running high in the tree.

Table 5-12 is a generalized guide for estimating tree mortality from primary fire effects. An "X" indicates that a tree of the species and diameter shown at left would probably die from the effects specified in the column heading.

***Table 5-12. Estimating mortality from primary fire effects***

| Species | Diameter | Crown Severely Damaged by Fire | | Partially Green Crown (≥30%) | | | |
|---|---|---|---|---|---|---|---|
| | | | | ≥50% Soil Exposed | | <50% Soil Exposed | |
| | | Crown consumed | Remaining live crown <30% of tree height | Deep char ≥50% of circumference in PP, DF, ≥25% in other species | Deep char <50% of circumference in PP, DF, <25% in other species | Deep char ≥50% of circumference in PP, DF, ≥25% in other species | Deep char <50% of circumference in PP, DF, __- 25% in other species |
| Ponderosa pine and western larch | <12" | X | X | X | | X | |
| | ≥12" | X | | X | | X | |
| Douglas-fir | <12" | X | X | X | X | X | |
| | ≥12" | X | X | X | | X | |
| Lodgepole pine | <12" | X | X | X | X | X | X |
| | ≥12" | X | X | X | X | X | |
| All other species | <12" | X | X | X | X | X | X |
| | ≥12" | X | X | X | X | X | X |

<u>**Estimating secondary fire effects on mortality**</u>

Bark beetles are a concern following the fires of 2000. Epidemics of other insects and diseases are not expected to occur as a result of the fires; in fact, diseases such as dwarf mistletoe and *Elytroderma* have actually declined.

Bark beetle outbreaks following wildfires are not unprecedented, but neither are they a foregone conclusion. Several conditions must exist for bark beetles to take advantage of fire-damaged hosts.

1. The fire-damaged trees must have a sufficient supply of undamaged inner bark for the beetles to feed on. If the inner bark becomes dry and darkened, as happens when trees are exposed to sufficient heat, beetles can neither feed nor deposit eggs.
2. The fires must occur at a time when beetles can take advantage of available food sources. Fires in late summer or early fall may occur after beetles have flown in a particular year. A tree's inner bark may dry out by the next spring and be of no use to beetles during the next flight season.
3. A population of beetles must exist within a reasonable distance of the fire-weakened trees.

**General effects of beetles after wildfire – precedents and research.** Although all three of the above conditions must be met for an outbreak to develop, such outbreaks have happened and are well documented in the Northern Region. Following the wildfires of 1988 and 1994, outbreaks of Douglas-fir beetle, spruce beetle (*D. rufipennis* [Kirby]), and pine engraver beetle became extensive and quite damaging in parts of the Region.

Following the 1988 Yellowstone National Park fires, Amman and Ryan (1991) concluded "The 1988 fires in the Greater Yellowstone Area killed many trees outright. Many more were subjected to sub-lethal injuries resulting in increased susceptibility to insect attack. Still other trees escaped fire injury but are exposed to the spread of insect attack from nearby injured trees." A follow-up report by Rasmussen et al. (1996) showed in the same area "that bark beetle and delayed tree mortality due to fire injury significantly alter mosaics of green and fire-injured trees, that insect infestation increases with the percent of basal circumference killed by fire, and that bark beetle populations appear to increase in fire-injured trees and then infest uninjured trees."

Ryan and Reinhardt (1988) demonstrated that post-fire mortality can be predicted as a function of crown scorch and bark thickness for most western conifers. Their studies concluded that probability of mortality increased with percentage of crown killed and decreased as bark thickness increased. Weatherby, et al. (1994) used those relationships in an effort to evaluate tree survival following the Lowman (Idaho) fire of 1989. In their study area, 82 percent of the ponderosa pine and 52 percent of the Douglas-fir survived the fire, but a significant portion of the trees that died were killed by bark beetles as opposed to direct fire effects. In fact, they noted that many larger diameter trees predicted to survive the fire were subsequently killed by Douglas-fir beetles.

Observations made following wildfires in western Montana have shown that Douglas-fir is particularly likely to be killed by Douglas-fir beetles if about half of the bole circumference has been adversely affected by fire. Occasionally the damage can be somewhat inconspicuous, especially if it affects large, lateral roots at or below the duff layer. Amman and Ryan (1991) showed 71 percent of the Douglas-fir on their Yellowstone plots died—more than twice as many as predicted by the model (using crown scorch and bark thickness characteristics). They surmised, "A possible explanation is that Douglas-fir tends to have large lateral roots near the soil surface that are often injured by fires. Thus, unmeasured root injury may have contributed to the

higher-than-expected mortality. However, because several of the dead Douglas-firs received minimal heating, insects appear to be responsible for part of the additional mortality."

**Predicting beetle activity following fires.** After the 1994 Little Wolf Fire (Tally Lake Ranger District, Flathead National Forest), stands affected by fire were categorized based on damage characteristics. Each category was assessed for its potential to be infested by insects in the years following the fire. These categories and assessments are as follows:

| Category | Characteristics | Assessment |
| --- | --- | --- |
| Black | Tree boles completely blackened and deeply charred, foliage destroyed, understory vegetation burned. | Few trees will be infested by insects. A few may attract wood wasps (horntails), but they are of little significance. Where charring destroyed or dried the phloem, there is no potential for bark beetle infestation. Wood borers (beetles families *Cerambycidae* and *Buprestidae*) ultimately feed in the sapwood but require relatively fresh inner bark for newly hatched larvae. These trees will harbor few insects and will also provide little food for woodpeckers or other insectivorous birds or mammals. |
| Black/ brown | Trees mostly blackened, but some foliage only browned. Understory vegetation mostly burned. | Thicker barked species such as Douglas-fir and ponderosa pine may survive immediate effects of the fire. In Douglas-fir, bole scorch on more than half the tree's circumference will likely produce a strong attraction for Douglas-fir beetles. Large-diameter, older ponderosa pines may be attacked by western pine beetles (*D. brevicomis* LeConte) or red turpentine beetles; however, "outbreak" development of these beetles in this situation would not be expected. Thin-barked species in this group (lodgepole pine, Engelmann spruce, subalpine fir) may have been burned too severely to attract bark beetles or wood borers. |
| Black/ brown/ green | Foliage mostly brown, some black and green patches | This group will attract the most bark beetles. Douglas-fir may be less affected, depending on degree of bark and root collar scorch. Most second-growth ponderosa pine, lodgepole pine, Engelmann spruce and subalpine fir will almost certainly be attacked by bark beetles or wood borers. Smaller diameter ponderosa pines and lodgepole pines will be infested by one or more species of engraver beetles (*Ips* spp.), other secondary bark beetles (*Pityogenes* spp. and *Pityophthorus* spp.), and wood-boring beetles. Mountain pine beetles are seldom attracted to fire-weakened trees. Spruce beetles will attack Engelmann spruce and subalpine fir will support populations of several beetles, the most dominant being western balsam bark beetle (*Dryocoetes confusus* Swaine). |

| **Category** | **Characteristics** | **Assessment** |
|---|---|---|
| Mixed green /some brown /some black | Mostly green foliage, some spotty brown or black areas | Bark beetle attraction will depend mostly on root collar damage. Most Douglas-fir and ponderosa pines will survive and not attract beetles unless smoldering ground fires significantly damaged roots or root collars. Other tree species are more likely to be infested, even though severe damage may not be apparent now. Observations in other burned areas have shown thin-barked trees can withstand only a small amount of damage at ground level without becoming so weakened they eventually succumb to bark beetle attacks. In these areas, it is common to find trees with little apparent bole or crown damage that have been completely girdled at the root collar. |

These assessments are not meant to be applied to those trees affected in the current year of the fire (2000), but to be applied to subsequent years (2001 – 2005).

**Predicting Douglas-fir beetle activity on the Bitterroot following the fires of 2000.**
To determine the number of stands on the Forest susceptible to insect attack after the fires, a hazard and risk rating was developed for DFB. Generally, "hazard" is defined as the likelihood of an outbreak within a specific time period, and "risk" is the expected loss should an outbreak occur. Hazard areas are those areas with smaller infestations that are anticipated to become further infested with the beetle within two - four years, if the epidemic expands. Risk and hazard is determined by stand density, percentage of DF, stand age and diameters, and current diseases and/or injury. Furniss and others (1979) state that stand susceptibility is positively correlated with the proportion of Douglas-fir in the stand, its density, and its age. A high hazard forest community would have the following characteristics: stand densities over 80 – 120% of normal or historic stocking, greater than 50 percent of DF component, average stand age greater than 120 years, and average diameter of DF greater than 14". A moderate hazard forest community would include those stands where one of the high hazard characteristics is slightly lower, and for the units in this project, moderate hazard is due to the percentage of DF component and stand densities.

Furniss et al., (1981) determined that there is a positive relationship between root diseased Douglas-fir and endemic populations of DFB. This relationship is not as pronounced during outbreaks. Injuries such as fire, wind and snow breakage, defoliation, winter desiccation, and forest damage are also believed to predispose trees or stand to beetle attack (Furniss et al., 1981). However, any factor(s) which substantially reduces tree vigor will render them more susceptible to beetle attack.

All stands containing Douglas-fir in moderate or low fire severity classes were analyzed to determine their hazard/risk rating. DFB will not attack dead trees; therefore, the high severity burned areas are not included in this hazard/risk rating. Because of the limited amount of stand exam data for this area, particularly in the wilderness, the hazard risk rating could not be done with TSMRS or R1EDIT data. The SILC (Satellite Imagery Land

Classification) data was used with some general assumptions to approximate what the hazard rating would be. All cover type codes that have any representation of Douglas-fir either pure or in a mixed species code were used. These codes included 4212, 4220, 4221, 4222, and 4223. SILC also has canopy coverages that were used in conjunction with size class. Essentially any code with Douglas-fir cover type, a high and medium canopy coverage, and medium and large size class code was coded as having high DFB hazard. Moderate was determined using Douglas-fir cover types, high and medium canopy coverage on pole size classes and low canopy coverage on medium, large, and pole size classes. See Map 5-4 in Appendix B for a spatial description and the following table with summary information.

Ratings are summarized in Tables 5-13 and 5-14.

***Table 5-13. DFB Risk on Douglas-fir stands in moderate or low fire severity areas***

| Analysis area | Rating | Acres | Percent of Burned area |
|---|---|---|---|
| Canyon/Blodgett/Mill/Sheafman | High | 1,093 | 9.55 |
| | Moderate | 1,288 | 11.25 |
| | **Total** | **2,380** | **20.79** |
| West Fork | High | 6,422 | 10.74 |
| | Moderate | 13,330 | 22.28 |
| | **Total** | **19,752** | **33.02** |
| Rye/Sleeping Child/Skalkaho | High | 24,385 | 22.68 |
| | Moderate | 22,821 | 21.22 |
| | **Total** | **47,206** | **43.90** |
| East Fork | High | 13,914 | 13.06 |
| | Moderate | 17,787 | 16.69 |
| | **Total** | **31,701** | **29.75** |

Table 5-14 includes the entire analysis area including burned and unburned acres. What we find in both tables is a tremendous amount of acres both burned and unburned within the analysis areas that are highly or moderately susceptible to beetle caused mortality. These numbers do not mean that trees on all acres will be attacked and/or killed. This just simply gives us an idea of the magnitude of the situation and what the potential is for future beetle infestation. The concern is more warranted in the West Fork and East Fork analysis areas because we had been experiencing a Douglas-fir bark beetle epidemic since 1998. Because beetle populations are present in close proximity to many thousands of acres of fire stressed trees, populations are expected to continue at epidemic levels.

If populations do continue at epidemic levels, green and unburned trees outside the burned perimeter could also be attacked. There are approximately 311,312 acres of high hazard/risk stands outside the burned area but within the analysis areas and 351,295 acres of moderate hazard/risk stands.

DFBs are not an aggressive beetle, however they are strong fliers and can move several miles. DFB typically thrive in large diameter downed trees. When their populations increase, they will attack standing trees that are also large in diameter, old, and showing signs of stress.

***Table 5-14. DFB Risk on Douglas-fir stands in moderate or low fire severity***

| Douglas-fir Beetle Rating | Classification | Acres | % of Rated Acres |
|---|---|---|---|
| High | Moderate Severity Burn | 20,708 | 32 |
| | Low Severity Burn | 41,365 | 65 |
| | Unburned within Analysis Areas | 1,791 | 3 |
| | **Total** | **63,864** | **100** |
| Moderate | Moderate Severity Burn | 18,634 | 25 |
| | Low Severity Burn | 52,149 | 71 |
| | Unburned within Analysis Areas | 2,581 | 4 |
| | **Total** | **73,364** | **100** |
| | **Grand Total** | **137,228** | |

### *4.5.4.9 Reforestation*

Some of the fires' most noticeable effects were in forest stands that had been regenerated in recent years. These stands had been treated with regeneration harvest (seed tree, shelterwood, or clearcut) and then planted or naturally regenerated. Regenerated stands burned at a variety of intensities.

Table 5-15 and Map 5-5 in Appendix B summarize the number of planted or naturally regenerated acres affected by the fires by analysis area. It is likely that most areas burned with high and moderate severity fires (especially those in VRUs 2 and 3) will need to be planted **(Figure 5-8, Appendix A)**.

The fires' effects on stand conditions are being surveyed. These surveys will also determine where planting will need to occur and where natural regeneration is likely.

***Table 5-15. Acres of plantations and natural regeneration burned in the fires of 2000***

| Analysis Area | Fire Severity | | | | | | | | Total Acres |
|---|---|---|---|---|---|---|---|---|---|
| | High | | Moderate | | Low | | Unburned | | |
| | Acres | % | Acres | % | Acres | % | Acres | % | |
| Canyon/Blodgett/Mill/Sheafman | 32 | 44 | 9 | 13 | 23 | 32 | 8 | 11 | 72 |
| Rye/Sleeping Child/Skalkaho | 3,589 | 31 | 3,817 | 33 | 3,520 | 30 | 772 | 7 | 11,698 |
| East Fork | 3,716 | 24 | 3,437 | 22 | 8,021 | 52 | 348 | 2 | 15,522 |
| West Fork | 115 | 9 | 988 | 74 | 230 | 17 | 0 | 0 | 1,333 |
| Totals | 7,452 | | 8,251 | | 11,794 | | 1,128 | | 28,625 |

**Natural regeneration potential.** Natural regeneration generally may occur on north, northeast, and northwest aspects above 5,800 feet elevation in subalpine fir habitat types (much of which is in VRU 4). The following table describes how much of each analysis area is suitable for natural regeneration.

***Table 5-16. Acres of natural regeneration potential by analysis area***

| Analysis Area | Acres | % of Burned Area |
|---|---|---|
| Canyon/Blodgett/Mill/Sheafman | 72 | 0.6 |
| Rye/Sleeping Child/Skalkaho | 22,070 | 20.5 |
| East Fork | 17,268 | 16.2 |
| West Fork | 5,465 | 9.13 |
| Totals | 44,875 | 17.08 |

Natural regeneration could be hindered by a lack of seed sources, especially for desired species such as ponderosa pine, western larch, Douglas-fir, lodgepole pine, and Engelmann spruce (western larch is a factor only in Canyon/Blodgett/Mill/Sheafman). Subalpine fir and grand fir are not normally used in artificial regeneration, but are very successful at natural regeneration on their preferred sites.

Cone and seed crops do not normally occur every year. Most conifers produce cones only periodically, governed by the species' biological characteristics and external conditions such as weather, insects, disease, and predation by birds and mammals. In general, ponderosa pine and spruce produce cone and seed every 4 to 6 years, Douglas-fir every 2 to 10 years, western larch every 1 to 10 years, and lodgepole pine every 2 to 4 years. Grand fir and subalpine fir produce seed crops every 2 to 4 years. It should be noted, however, that all species could naturally regenerate on most sites when conditions are favorable.

Debate has centered on the probability of success in efforts to naturally or artificially reforest burned areas. Before the fires of 2000, success of both artificial and natural regeneration was quite high. Table 5-17 displays regeneration success on the Bitterroot National Forest from 1976 to 1999.

***Table 5-17. Regeneration success in managed stands, 1976-1999***

| Analysis Area | Plantation success % | Natural regen success % | Plantations- Avg yrs to satisfactory stocking | Natural- Avg yrs to satisfactory stocking |
|---|---|---|---|---|
| Canyon/Blodgett/Mill/Sheafman | 100 | 100 | 2.50 | 5.50 |
| Rye/Sleeping Child/Skalkaho | 99 | 98 | 2.92 | 3.23 |
| East Fork | 100 | 99 | 3.34 | 5.00 |
| West Fork | 100 | 100 | 3.68 | 4.03 |
| Average | 100 | 99 | 3.11 | 4.44 |

In the spring of 2000, Douglas-fir on the Bitterroot had a good cone crop and ponderosa pine had a fair crop. Post-fire field verification determined that Douglas-fir seed was quite abundant on most of the sites where a seed source was left. Where the fires burned intensely they consumed needles and cones, leaving few seeds. Depending on the size and shape of the burned area, a seed source might be available nearby.

Field observations led to the following conclusions regarding seed sources and probable success of natural regeneration.

- Much of VRU 2 experienced lethal fires. These areas will have to be artificially planted with ponderosa pine and Douglas-fir. Some of these sites have had problems regenerating naturally in the past because 1) these drier sites are not conducive to successful establishment of seedlings, 2) ponderosa pine and Douglas-fir may not produce cones or seeds for as long as 7 years, and 3) it has been difficult to achieve and insure a species mix that is compatible to the area.

- Some of the ponderosa pine that did survive the fire in mixed severity fire area are large diameter, old, and have flat-topped crowns. It is unlikely that these trees will provide an adequate seed source because they are beyond seed bearing age. However, younger ponderosa pine may very likely be good seed sources in the future.

- The Bitterroot has not seen a good ponderosa pine cone crop in over 12 years. The reason for this is not known, and the problem has become quite a concern.

- Natural regeneration is possible on some VRU 3 sites. Artificial regeneration may be necessary to provide species diversity.

- Natural regeneration is quite possible on most VRU 4 the sites, except where seed sources have completely burned and/or burned area size is quite large. In VRU 4 there were as many lodgepole pine stands before the fires. Because of the serotinous nature of lodgepole pine cones, seed should be plentiful. Provided a cone/seed crop was present at the time of the fire and was not completely destroyed, natural regeneration should occur. If environmental and biological conditions stay within normal parameters for this area over the next 3 to 5 years, natural lodgepole pine regeneration should be a success.

- In general, success in planting the burned area will be challenging. In areas where all vegetation was lost, it will be difficult to adequately protect regeneration from environmental conditions. Browsing deer and elk may threaten success of regeneration on migration routes and winter range. South, southeast, and southwest aspects exposed by the fires will be more susceptible to drought conditions.

In **VRU 2**, harsh exposed sites, drought conditions, animal damage, and the lack of a seed source will challenge regeneration success. Competition from other types of vegetation will not be a major concern for either natural or artificial regeneration on these sites for the next 3 to 6 years.

Competing vegetation will become an issue in **VRU 3** as early as the second year after the fires, especially on north, northeast, and west aspects. Other sites within VRU 3 can expect considerable competition in 3 to 4 years, which will lessen the success rate for natural regeneration. Scalping of the competing vegetation will be necessary after the second year and will result in increased planting costs after year three.

Providing seed sources are available and site preparation is sufficient, natural regeneration should occur in **VRU 4** before competing vegetation becomes established. *Xerophyllum tenax* (beargrass) will be prevalent on most aspects and *Menziesia ferruginea* (menziesia) will dominate the cooler north slopes, but neither will hamper regeneration for at least 2 to 4 years. It is anticipated that very little planting will occur in these units.

As mentioned above, the success of natural regeneration depends on factors such as seed availability, drought, site preparation, animal damage, etc. Where natural regeneration takes place, stand origin and species designation will be based on what is currently there and what was there in the past. Any undesirable characteristics or genetic dysfunctions will be perpetuated in the future stand. Artificial regeneration allows us to introduce, in some cases, better adapted species that are more disease resistant, grow better on the given site, and result in a more diverse stand.

Success of natural regeneration will also be determined by the reburn experienced in 2000. Many of the managed stands were burned for site preparation using broadcast or underburning. It is unknown the resulting conditions of a reburn on nutrient availability, mycorrhizae, future nutrient cycling with a lack of large coarse woody debris, etc.

## 4.5.5 Historic and Pre-fire Conditions: Selway and Salmon River Drainages

### *4.5.5.1 Historic and Pre-fire Conditions*

Natural ecosystems and processes are relatively intact here as compared to other watersheds in the Interior Columbia River Basin. The effects of fire exclusion have nevertheless been pervasive across the sub-basin, and the effects of harvest have been locally important in determining composition, structure, and function. The effects of introduced organisms have had highly significant impacts in a few specific situations, e.g. whitebark pine.

**Changes in composition of vegetation.** The greatest departures in vegetation composition are:

- Severe declines in whitebark pine due to fire exclusion, blister rust, and mountain pine beetle. Alpine larch has also been affected by fire exclusion.
- Significant declines in ponderosa pine (especially large pine in open stands) due to fire suppression and forest succession.
- Increases in more shade tolerant tree species such as grand fir and western red cedar due to fire suppression and forest succession. Subalpine fir does not appear to have increased.
- An increase in lodgepole pine, probably due to conifer establishment on old burns.
- Moderate declines in shrubland due to forest succession.
- Montane parkland has increased due to succession on burned areas and areas of thin soil.

**Changes in forest structure** may be considered both within communities (stand size, canopy density, canopy layers) and across communities. Greatest departures of size-class are:

- The area that is not forested has decreased as forests have become established on old burns. Today, most areas that remain unforested are high-elevation rocky ridges and dry slopes that can't support tree growth.
- Seedling/sapling and pole classes have increased in area due to tree growth on old burns.

**Canopy density** is an important structural attribute because it affects plant vigor, susceptibility to insects and disease, potential for crown fire, wildlife cover, and successional pathways. Departures in canopy density have occurred in all classes.

- More acres are forested, probably due to fire exclusion.
- Establishment of seedlings and saplings on old burns has resulted in more acres of forest with low canopy density.
- Areas with moderately dense canopy have declined in size while areas of dense canopy have increased. Both are probably a result of fire exclusion. The number of vertical layers in the canopy has likely accompanied this as young, shade-tolerant trees grow up beneath the overstory. Increased canopy density and layering indicate a greater probability of crown fires, severe fire effects, and consequently effects on sediment regimes and successional pathways.

**Landscape structure.** Forest patches are defined as contiguous areas of similar general vegetation structure. Across the landscape, changes in patch size and extent have implications for wildlife, watershed processes such as erosion, and plant species that are adapted to certain scales of migration and colonization. Vegetation structures are defined as follows:

| | |
|---|---|
| Open early-seral | Patches include shrubs, herbaceous communities, and open seedling or pole stands |
| Closed early-seral | Seedling or pole stands with moderate or high density canopy |
| Open mid-seral | Medium-sized trees with low canopy density |
| Closed mid seral | Medium-sized trees with moderate or high canopy density |
| Open late seral | Large trees with low canopy density |
| Closed late seral | Large trees with moderate or high canopy density |

It appears that the following departures in landscape structure have occurred since settlement:

- Average and maximum patch size of open early seral communities has decreased. This is probably due to a combination of fire suppression and closed-forest succession. The total extent of open early-seral communities appears to have increased, but this may be due to the development of montane park or alpine scrub on formerly barren ridges.
- Closed seedling/sapling and pole classes have increased due to increasing stand density on old burns.
- Mid-seral open forest has increased in extent but declined in patch size. Some of the increase may be due to mortality in mixed subalpine fir-whitebark pine stands or increased root rot mortality in mesic mixed conifer stands.
- Mid-seral closed forest has decreased in extent, patch size, and variability. Transition to late-seral closed forest may have caused part of this change; conversely, mortality that has shifted the stands to more open conditions may also be a factor.

Late-seral open forest has decreased in extent, patch size, and variability of patch size. This is probably due to an increase in stand density and coalescence of adjacent stands into closed canopy conditions – both results of fire exclusion.

***Table 5-18. Historic Vegetation Classes from 1914***

| Size class in 1911 | Percent of surveyed area |
|---|---|
| Alpine | 7 |
| Barren | 12 |
| Grassland | 3 |
| Recent burn (includes seedlings and saplings) | 13 |
| Low volume timber (open poles or medium-sized trees) | 15 |
| High volume timber (closed poles or medium-sized trees, large trees) | 47 |
| Not mapped | 5 |

John Leiberg surveyed the Selway sub-basin as part of the Bitterroot Forest Reserve in 1897-98 (Leiberg, 1898). His surveys showed that burns had occurred recently (within about the last 40 years) on approximately 35 percent of the area. Small trees (poles) or open stands of medium-sized trees probably amounted to about another 40 percent. Dense stands of medium-size trees and open to dense stands of large trees occupied less than 25 percent of the area in the drainages. Thirty-four percent of the area surveyed was dominated by Douglas-fir. Ponderosa pine, which occupied 21 percent of the area, occurred as pure and mixed stands in the canyons below 6,000 feet. Lodgepole pine covered 17 percent of the area and dominated middle elevation forests in the Selway headwaters. Western larch and western white pine were quite uncommon. Whitebark pine and alpine larch were widely distributed above 6,000 feet but seldom were dominant. Subalpine fir and Engelmann spruce occupied about 18 percent of the drainages between 6,000 and about 8,000 feet.

### *4.5.5.2 Pre-fire Conditions*

**Pattern of plant communities in the landscape.** Fire suppression and advancing succession have changed the distribution of seral stages in this part of the National Forest. Open, early-seral communities have decreased in average and maximum patch size, but only slightly in extent. Where once they occurred in a variety of terrain settings, they are now more likely to be found only in warm canyons or on high elevation ridges. Early-seral closed forest has increased greatly in extent and maximum patch size as old burns have reforested. Mid-seral open forest has increased while mid-seral closed forest has decreased, perhaps due to increased pathogen activity or transition to later seral stages. Late-seral open forest has decreased greatly in extent and maximum patch size due to fire suppression. Late-seral closed canopy forest has increased, also due to fire suppression.

**Plant community composition.** Whitebark pine has decreased dramatically due to fire suppression, blister rust, and mountain pine beetle activity. Alpine larch has also decreased. Acres of open stands with large ponderosa pine have decreased due to forest succession and suppression of fire. The same factors have led to an increase in the more shade-tolerant species like grand fir and western red cedar. Old burns now support lodgepole pine. Shrublands have decreased with forest succession. Patches of recent burns have decreased. Annual grasslands and noxious weeds have become established on south-facing slopes that are steep, open, and at low elevation. The forest's component of western white pine has decreased from its minor historic levels due to blister rust and forest succession. Montane parkland has increased as old burns and denuded areas have revegetated and whitebark pine has been lost.

**Plant community structure.** Non-forest plant communities have decreased due to forest establishment on old burns. Harvest and recent burns have not occurred at the same rate or had the same ecological effects as pre-settlement fire disturbance. Seedling/ sapling and pole forests have increased due to tree growth on old burns.

Areas of sparse tree canopy cover and total forest cover have increased as young forest has grown on old burns. Moderately dense tree canopy has decreased, probably due to the effects of forest succession combined with suppression of fire.

**Pathogen activity.** Succession has shifted this part of the forest towards late-seral species such as Douglas-fir and true firs. Pathogens such as root rots and spruce budworm, associated with late-seral species, have also increased. Susceptibility to insects associated with larger, aging Douglas-fir and lodgepole pine has increased, as the current Douglas-fir bark beetle epidemic in the Selway drainage shows. Whitebark pine has widely succumbed to blister rust and mountain pine beetle activity. Increased stand density means that more stands are under competitive stress for moisture and nutrients. Such stress makes trees more susceptible to pathogens that might otherwise exist only at endemic levels.

**Fire regimes.** The interval between fires has increased markedly in areas once dominated by frequent fire. This departure, and the consequent increased fuel quantity and continuity, indicates that future fires could have more severe effects on watershed and successional processes than did pre-settlement fires.

**Plant communities of concern.** Whitebark pine communities have been the most affected in Selway-Salmon sub-basin. Communities dominated by whitebark pine appear to have declined by approximately 92 percent. Montane parklands or mixed subalpine forest has replaced the pine. Aspen and other hardwood communities appear to have decreased as a result of fire suppression, but changes at this fine scale are poorly tracked. Mountain grassland communities have been severely impacted by non-native plants at low elevations along the river corridors. Open ponderosa pine forest has decreased with encroachment of more tolerant Douglas-fir and grand fir.

**Late seral stands.** Total area in mature forest is greater today than it was historically. In canyons and at higher elevation glaciated settings, mature and late-seral forest appears to have increased as a result of fire exclusion. Conditions now tend more towards multiple layers, mixed species, and late seral stages, while open, old growth ponderosa pine has decreased.

### *4.5.5.3 Insects and Disease*

The following discussion addresses just one aspect of forest health: the changes that have occurred in forest vegetation, and how these are likely to affect susceptibility to insect and disease organisms.

**Western spruce budworm.** A common defoliating insect in the Selway-Salmon sub-basin is the western spruce budworm. Outbreaks seem to be sporadic; they can cause mortality or susceptibility to bark beetle attack in vulnerable tree species. Hosts are later seral species like grand fir, subalpine fir, Engelmann spruce, and Douglas-fir, all of which have increased in forest area with fire suppression. Attacks are more severe

where trees are stressed by overcrowding or drought or where multistory stands of susceptible trees exist. Natural controlling agents are such predators and parasites as wasps, flies, birds, ants, spiders, and beetles. Changes in vegetation in the sub-basin suggest that susceptibility to budworm outbreaks is probably greater now than pre-settlement, mainly because of changes in tree species composition and stand density at middle and lower elevations. Actual changes in activity levels have not been observed, however, perhaps due to the sporadic nature of budworm outbreaks and their dependence on other climatic factors. Populations of budworm are expected to increase across the region according to historic and current population trends.

**Pine beetles.** Mountain pine beetles attack ponderosa pine, lodgepole pine, western white pine, and whitebark pine. They select larger (usually older) trees and those stressed by drought or other agents. The cycle in which older lodgepole pine are killed by beetle activity and burned, followed by sites regenerating to lodgepole pine, is widely recognized (Amman and Ryan, 1991).

**Douglas-fir beetle.** Fire suppression has allowed more Douglas-fir to grow into the larger size classes that are susceptible to attack by Douglas-fir beetles. Regional aerial surveys of insect-caused tree mortality indicate very high levels of Douglas-fir beetle activity in the Upper Selway, where departures from historic fire frequency are marked and stand density has increased. Historically, beetle activity levels were strongly linked to patterns of fire and drought. Trees weakened by fire or stressed by drought are most susceptible. Patches of fire-stressed trees used to occur periodically; today, large, continuous areas of older, fire-stressed trees are present, and epidemic outbreaks of Douglas-fir bark beetles may occur across larger areas and last for longer periods of time.

**Blister rust** is an exotic pathogen that was introduced to the United States in 1909. Western white pine and whitebark pine are highly susceptible. There has been considerable progress in development of rust resistant white pine varieties, but little work has been done with whitebark pine. Whitebark pine is being replaced in the sub-basin by subalpine fir, Engelmann spruce, lodgepole pine, and montane herblands or shrublands (Quigley et al., 1997).

**Root diseases** are caused by fungi and can affect trees of all sizes, ages, and species. In the sub-basin, grand fir and Douglas-fir are the most highly susceptible species, and the prevailing root pathogens affecting them are *Armillaria* and annous root rots. The areas susceptible to root disease appear to have increased as forests in the sub-basin have shifted more to grand fir and Douglas-fir. The effect has been more forest openings, which favor shrubs, hardwoods, and regeneration of more susceptible grand fir and Douglas-fir. Inoculum levels have probably increased in some areas. At very high levels, other tree species become susceptible. Fire tends to decrease root rot by favoring more resistant species such as pine or western larch.

**Dwarf mistletoe** most commonly infects Douglas-fir and lodgepole pine in these drainages. The characteristic witch's brooms, indicative of mistletoe, provide hiding cover and resting areas for birds and small mammals. Mistletoe decreases tree vigor. The plant parasite spreads more readily in dense or two-story stands. These changes are likely to have occurred in many lower and middle elevation Douglas-fir stands. Spread of mistletoe is unlikely in lodgepole stands, which are more likely to have Engelmann spruce and fir in the understory. Stand-replacing fire eliminates mistletoe from the affected area for a while.

## 4.5.6 Effects and Implications of the Fires of 2000: Selway and Salmon River Drainages

In general, most of the fires burned with mixed severity in this analysis area and are within the historic range of the natural fire regime. Areas where the fires did not burn "naturally" due to the build up of fuels and succession were within the low-elevation, dry ponderosa pine/Douglas-fir communities.

Although thousands of acres were burned in 2000, much of the pre-fire condition still exists across the analysis area. Furthermore, the analysis area sits in a landscape that includes both the Frank Church and Selway-Bitterroot wilderness areas. At this scale, the conditions described did not radically change as result of the fires. Within smaller watersheds, plant community composition, structure, health, etc. did change noticeably as a result of the fires of 2000.

## 4.5.7 Desired Conditions

### *4.5.7.1 Bitterroot River Drainage*

**VRU 2** - The desired future condition would more closely approximate the reference condition. It is desired to treat noxious weeds to maintain their populations at low levels and treat new invaders before they become a problem on important winter range areas. Prescribed fire should be scheduled at one-fifth to one-half of the VRU per decade consisting of spring burns. Since spring burns tend to promote Douglas-fir, slashing will be necessary. Maintenance of insects and disease at endemic levels is desirable. Harvesting could be designed to increase the number of large diameter trees and to increase the percentage of ponderosa pine.

The desired future condition includes those structures, composition, and processes that would have been present historically. It is desirable to return fire to the ecosystem and allow it to play its natural role. It is desired to maintain fuel loadings as would be expected historically by incorporating methods to restore the historic fire regime. Insects and diseases are desired to be maintained at endemic levels.

**Specific Desired Future Condition Characteristics of VRU 2 -** The target condition includes:

- A mix of successional stages ranging from grass/forb, early seral (seedling/sapling) to late seral with approximately 60% of the stand in late seral condition and 15% less than 40 years of age,
- Reduce stocking levels by reducing stand densities to between 40 – 80 square feet of basal area per acre in areas where the fire didn't achieve this target,
- Where regeneration is necessary due to the amount of mortality, stocking at 150 trees per acre of ponderosa pine is desired 5 years following the fire or after a final harvest,
- Improve the overall health of the stands by creating or changing the species mixture to 70 - 85% ponderosa pine and 15 - 30% Douglas-fir, and
- Improve the overall productivity of the stands by reducing competition and creating more growing space.

These characteristics will encourage the development of shade-intolerant species in one or two cohorts across the area and in openings. Stand structures are desired to be one, two, or three storied, often with an irregular overstory of fire-resistant ponderosa pine and Douglas-fir greater than 120 years old. Scattered large ponderosa pine exhibiting mature "yellow bark" characteristics is desirable. Regeneration would include at least 75% ponderosa pine. Consistency of tree stocking levels would be typical for the forest vegetation present and the long-term disturbances expected.

Providing larger diameter dead trees and patches for woodpecker feeding and other wildlife species is desired. It is desirable to retain the recommended range of downed woody debris as shown in the course woody debris guidelines at the end of this section.

It is desired to have a very low component of noxious weeds present. High value (palatable and high in nutrient content) shrub and grass component is desired. Intolerant shrub species is more desirable than tolerant shrubs; for example, serviceberry, ceanothus, scoular willow, and chokecherry are desired over ninebark.

**VRU 3** - The desired future conditions would again be the same as the reference condition except to ensure maintenance of desired amounts of old growth characteristics in late seral stands. Noxious weed management is also desired. Continued suppression of wildfire is desired except on the driest end of this VRU where prescribed fire is deemed beneficial. Prescribed fire should also be associated with harvest units. Ideally, it is desired to maintain a fire hazard as would be expected historically by incorporating methods to restore the historic fire regime. Insects and diseases are desired to be maintained at endemic levels.

**Specific desired future condition characteristics of the moist Douglas-fir sites -** Native ecosystems of this type had the most diverse array of trees, frequently dominated by Douglas-fir and lodgepole pine. Ponderosa pine existed with other species on the drier

sites. Engelmann spruce and subalpine fir were evident in the cooler, moist portions of this type. Stocking between 80 and 120 square feet of basal area per acre is desired.

It is desirable to develop pre-suppression composition and structures that included a mix of even and multi-aged stands of Douglas-fir and/or lodgepole pine with stocking ranging from fairly open to dense. This will allow age and size differences between stands to create edge. More early seral stands at a landscape scale as well as large patches of fire killed dead and down are desirable.

- A mix of successional stages ranging from early seral (seedling/sapling) to late seral with patch sizes varying between 10 and several hundred acres;
- Reduce stocking levels by reducing stand densities to between 80 – 100 square feet of basal area per acre;
- Where regeneration is necessary due to the amount of mortality, stocking at 250 trees per acre of Douglas-fir and lodgepole pine is desired 5 years following the fires or the final harvest;
- Species mixture should include 80 - 90% Douglas-fir and lodgepole and 10 - 20% other species such as subalpine fir and Engelmann spruce; and
- Improve the overall productivity of the stands by reducing competition and creating more growing space.

Stand structures are desired to be one or two, often with an irregular overstory of snags and snag replacements of fire-resistant Douglas-fir greater than 120 years old. Providing larger diameter dead trees and patches for woodpecker feeding and other wildlife species is desired. It is desirable to retain the recommended range of downed woody debris as shown in the table at the end of this section.

**VRU 4** - The desired future conditions would again be similar to the reference but with more seral species in various stages and lower densities. The creation of landscape mosaics of age/size classes to prevent a landscape mountain pine beetle epidemic in the next rotation as well as a landscape scale stand replacement fire event is desired socially.

Large patches of seral species with large patches of structural diversity across landscape is desired. This would include a large component of standing dead; both fire killed and insect and disease associated mortality. Burns would typically be associated with timber harvest or prescribed fire. Fire and harvest would be used to replace reference condition fires by breaking up successional stage (i.e.- discourage having the whole area as one successional stage because it leads to massive sudden changes). Insects and diseases are desired to be maintained at endemic levels.

**VRU 5** - Same as the reference condition.

**Specific recommendations on snag, snag recruitments, and large coarse woody debris by VRU** - The following table includes guidelines for implementation for snags and

coarse woody debris by VRU. These guidelines were developed by an interdisciplinary team of resource specialists to achieve recommendations that balance near-term "on the ground" soil needs, long-term soil needs, desired structural components, wildlife habitat, and historic fuel loading. The resource specialists included a wildlife biologist, silviculturist, soil scientist, and fuels specialist. Literature used to develop these guidelines included Graham et al., 1994; Fischer and Bradley, 1987; and Evans and Martens, 1995. These guidelines include:

- It is desirable to retain the recommended range of downed woody debris with material generally in larger size classes, but greater than 4" in diameter and well distributed across the treatment area (Graham et al., 1994).
- Material should also vary by species and by size classes across the treatment area.
- Smaller diameter stands may approach the coarse woody debris requirement at the lower end of the range.
- If it is determined that the treatment area can not meet these guidelines, then the decision to treat commercially may not be ecologically sound. These areas may be prescribed for a non-commercial treatment instead.
- Sites that have sensitive or hydrophobic soils, previous soil compaction, and/or erosion potential should be prescribed on the high end of the recommended ranges.
- With commercial harvesting, tops should be left in areas with moderate and high severity.
- The lower end of the range should also be used for those habitats on the drier end of each VRU.
- Many stands will not be able to supply green/live snag replacements. This guideline should only be used where it is possible to leave live trees per acre.

***Table 5.19. Coarse Woody Debris and Snag Guidelines by VRU***

| VRU | Fire Severity | Coarse Woody Debris (tons) | Size Class | Snags (trees per acre) | Snag Replacements (live trees per acre) |
|---|---|---|---|---|---|
| 2 | Interface lands | 5 – 10 | Range > 4" | 2 - 5 | 8 - 12 |
| | Low | 5 – 15 | Range > 4" | 2 - 5 | 8 - 12 |
| | Moderate/High | 10 –15 | Range > 4" | Where snags are >15" dbh, leave 10; otherwise leave 2 – 5 | 8 - 12 |
| 3 | Interface lands | 15 – 20 | Maximize dia > 8", No more than 5 tons/acre in 4 – 8" size class | 4 – 12 | 8 - 12 |
| | Low | 20 – 25 | Range > 4" | 4 – 12 | 8 - 12 |

| | | | | | |
|---|---|---|---|---|---|
| | Moderate/High | 20 - 30 | Approach 5 tons/acre in the 4 – 8" size class | 4 – 12 | 8 - 12 |
| 4 | Interface lands | 15 - 20 | Range > 4" | 5 – 15 | 8 - 12 |
| | Low | 25 - 30 | Range > 4" | 5 – 15 | 8 - 12 |
| | Moderate/High | 25 - 30 | Approach 5 tons/acre in the 4 – 8" size class | 10 – 15 | 8 - 12 |

#### *4.5.7.2 Selway and Salmon River Drainages*

Because of the wilderness character of this analysis area, the desired future condition is the reference condition. It is not expected that this desired condition be achieved within a certain time period, however wildland fire should be used to approach this condition over time. Emphasis will be needed to address the decline of whitebark pine and the best restoration approach for this analysis area, but also for different scales.

### 4.5.8 Synthesis and Interpretation: Bitterroot River Drainage

This section will be addressed by revisitng the issues raised and supplying a short summary of the previous sections to answer.

**Were the fires of 2000 natural events?** Yes and No. In the lower elevation dry ponderosa pine and Douglas-fir types the natural or historic fire regime was generally frequent and non-lethal with a relatively uniform pattern. Average fire frequency ranged between 5 and 25 years. Before man suppressed fires, forest composition and structure was typically open, park-like, multi-storied and multi-aged stands of ponderosa pine and Douglas-fir. With the absence of fires, these stand have become overstocked and created "unnatural" conditions. Where areas of these types burned high or moderate severity this summer, this should be considered an unnatural fire event. Where the fire burned as a light underburn, this can be considered natural.

Much of the other vegetation types found in the Bitterroot did burn as they might have under natural conditions, creating a mosaic pattern across the landscape. The question is - is the size and extent of these fires natural? Had we allowed fires to play their natural role in these landscapes, more age and size class diversity would have been created over time (like Sleeping Child or Saddle Mountain fires). It is likely the fires of 2000 would not have grown to the extent they did had there been more diversity at the landscape scale.

**How did past harvest practices influence the fire behavior of 2000?** Throughout the burned area there are examples where past management did reduce fire intensity and influence fire behavior by creating fuel breaks. However, there are also examples where

past management did not change fire behavior significantly, the end result was still a lethal fire event. study is desired to address this question.

**What will be the effects on beetle populations after the fires?** Douglas-fir bark beetle is expected to be of great concern because of the large number of fire stressed Douglas-fir trees and the epidemic that was present prior to the fires. Beetle caused mortality should increase over the next few years, possibly allowing epidemic populations to continue. Spruce beetle and pine engraver beetle may also be of concern and have the potential to cause damaging effects in fire stressed trees. All other beetles will be seen across the burned area, but not expected to build populations or cause widespread mortality.

**What kind of mortality can we expect in fire weakened trees in the next 2 – 5 years?** With the effects of the fire on crown damage, deep char around the bole of the tree resulting in stem damage, and the root damage; estimatations can be made on predicting tree mortality. Generally trees with greater than 30% green crown, less than 50% deep char, and less than 50% bare mineral soil exposure have the highest probability of living.

Beetle mortality can generally be expected in trees predominately blackened with some foliage browned and in trees having mostly brown foliage and some green foliage as well.

**What are the effects of fire exclusion on forest structure, diversity, and forestland integrity before the fires and what does that mean now after the fires?**

Fire exclusion has left the Bitterroot landscape in a different mosaic than if fires were allowed to play their natural role. Homogenous structures dominated the landscape with large contiguous polygons of older and densely stocked stands prior to the fires of 2000. This has contributed greatly to the Douglas-fir bark beetle epidemic on the south half of the Forest prior to the fires. This condition may have also contributed to the size and extent of the fires of 2000 because the mosaic did not provide enough diversity in terms of tree size classes, densities, age, and structure.

Structures across the landscape have changed due to the fires of 2000 and a more diverse landscape is being shaped. However, the distribution of age/size classes across the landscape still does not reflect historic distribution.

**What about future fuel loadings?** Undoubtedly, future fuel loadings are a concern. If we do not remove dead trees, and instead, allow them to accumulate on the forest floor over time, will we not be in a worse situation 20 years from now than we were before the fires of 2000? This is of particular concern where we have made an investment in the land by planting trees.

Fuel loading prior to the fires of 2000 were beyond the natural range in some areas, particularly in the low elevation warm and dry ponderosa pine/Douglas-fir vegetation types. Consideration of the natural range of fuels is necessary to determine if action is

need to be taken to remove fuels as part of the recovery/restoration effort.

**What are the plans for reforestation?** Although there is a need for artificial regeneration in many areas, natural regeneration also has great potential within the fire perimeter. Planting will be focused in the interface, where ponderosa pine is needed to meet desired species composition, and where no seed sources are available for natural regeneration. Planting will begin in a portion of the burned area as soon as the spring of 2001 and will likely continue for the next 5 to 7 years.

## 4.5.9 Recommendations: Bitterroot River Drainage

All treatments associated with these recommendations should emphasize removing smaller green and dead trees with greater attention to prevention of mortality rather than the removal of large dead trees, establish stands where consistency of tree stocking levels with long-term disturbances are typical for the forest vegetation present, and emphasize changes in structure and composition at the watershed level and increase diversity at this scale.

### *4.5.9.1 Artificial Revegetation/Reforestation*

The following areas are listed in order according to their priority.

- **Priority #1 = Areas within the North Fork Rye Fire of 1998 (approximately 200 acres)** – These acres need to be planted before site preparation is lost after 2002. Much of these acres are in need of planting ponderosa pine to achieve desired future conditions.

- **Priority #2 = Past Regeneration Units (in most or all VRU's)** – These areas are scattered throughout the burned area and include past regeneration units from the 1960s to the mid 1990s. Because of a lack of seed source on much of this ground, artificial regeneration is necessary. Some artificial regeneration will need to wait until the fuels treatments are completed. Some of the ponderosa pine terraces created in the 1960s were implemented on lands where few or no trees previously existed. Using historical photos, these lands need to be identified and not replanted artificially.

- **Priority #3 = Burned Interface** – This will include areas to artificially regenerate after vegetation/fuels treatments are completed, or where no vegetation/fuels treatment opportunity exists.

- **Priority #4 = VRU 2** - This will include the areas of lethal fire and some mixed severity fire. Because ponderosa pine is the seral species and a key feature for the restoration of these areas, it will need to be planted. As mentioned

previously in this report, the Forest has had difficulty naturally regenerating these sites in the past, therefore artificial means are necessary to get these sites revegetated and with the desired species mix. On the Blodgett Fire these areas can be planted with western larch. Stocking should be at least 12 by 12 foot spacing rather than the traditional 8 by 8 foot spacing. These lands will likely be put on a burning maintenance schedule and stocking needs to be consistent with historical stocking to meet desired condition and facilitate frequent prescribed burning.

Acres include areas identified by the BAER teams as priorities for reforestation for long-term mitigation against noxious weeds in areas at high risk to invasion. The BAER teams also determined reforestation was needed to deal with the long-term need of soil stabilization on areas of severely burned sites with highly sensitive soils.

- **Priority #5 = VRU's 3 and 4** – These areas include: acres where no seed source is left limiting the potential for natural regeneration, areas where the polygon size of the lethal fire event limits natural regeneration due to the distance from the nearest seedwall, or where the desired species mix will not be achieved with natural regeneration.

- **Priority #6 = VRU 5** – These areas include acres where whitebark pine might be artificially regenerated.

- **Priority #7 = Revegetation with native shrubs, grasses, and forbs after noxious weed control measures** – These acres include areas where noxious weeds have overtaken the native vegetation over the years leaving a very low percentage or coverage of these species. After the fires of 2000, it is expected that these site will have very little native vegetation naturally recovering due to the lack of seed or sprouting source. Supplementing these areas by planting and/or seeding is necessary to achieve restoration goals.

### *4.5.9.2 Burned Area Vegetation Treatments*

These treatments are described by priority (treatment only reflects Management Areas 1, 2, 3a, 3b, and 3c and exclude roadless areas). Spatially all vegetation treatments prioritized by analysis areas include: Blodgett, East Fork, Rye/Sleeping Child/Skalkaho, and West Fork respectively.

1. **Burned Interface** – An integrated silviculture/fuels approach in treatment of these lands should be considered the highest priority for the vegetation resource for a variety of reasons (see Map 5-6 in Appendix B). As adjacent private landowners and the Montana Department of Natural Resources and Conservation begin to treat their lands, it is appropriate for the Forest Service to do the same as good neighbors and land stewards. The Forest Service has an opportunity to demonstrate good land

stewardship after such and event and provide examples of fuel treatment and vegetation management in these areas.

Many people, particularly those living in the interface, have expressed a desired to "green it up" as fast as possible. After a vegetation/fuels treatment has been completed, planting should be implemented. Planting in areas where no treatment is necessary should begin immediately. Being active and fastidious to "green it up" would be socially, mentally, and spiritually beneficial and lend itself to the healing and recovery process.

- **High/Moderate Fire Severity Areas** - Fuel accumulation over the next couple of decades will be of concern not only from a reburn potential, but also from a stand development standpoint. Much of this ground is within VRU 2 where a large accumulation of fuels would be unnatural, particularly where there were unnatural fuel buildups before the fires of 2000. As with most of VRU 2 that burned of this intensity, these areas will likely need to be artificially regenerated to ponderosa pine. It would not be wise to invest in planting, but still have heavy fuel loading present where 20 years from now the fire potential is quite high for another high intensity fire. If this occurred, these areas would undoubtedly be without an onsite seed source and would have some long term effects from loss of soil productivity.

  We must remember that following the fires of 1910, a series of reburns occurred, some as soon as 1919. Although intense reburns may be a natural event for VRU 4, it is not necessarily a natural situation for VRU 2. For this reason it is both ecologically and socially sound to treat fuels within these areas.

- **Low Severity Areas** – These areas should be treated to prevent increased mortality from insects. It is essential that these areas be treated to create the desired future condition and maintained as such to reduce the fire risk in the future.

**2. Fuels Treatment in Past Regeneration Harvest Units > 20 Years of Age –** The majority of these treatments will include mechanical and hand methods of dealing with fuels accumulations that are determined to exceed needs for coarse woody debris and be a hazard and increase fire risk in the future. The first priority includes those acres expected to be planted followed by those expected to naturally regenerate on their own (see Map 5-7 in Appendix B)

**3. VRU 2 –** An integrated silviculture/fuels approach in treatment of these lands should be considered the third highest priority for the vegetation resource for a variety of reasons. Treatments will include using commercial entry, prescribed fire, and/or mechanical and hand fuels treatments. Where areas will need to be treated before planting, this activity needs to be done within the next two years to ensure

that site prep is captured and limit the competing vegetation situation associated with this VRU.

- **High/Moderate Fire Severity Areas** (see Map 5-8 in Appendix B) - As with the black interface, fuel accumulation over the next couple of decades will be of concern not only from a reburn potential, but also from a stand development standpoint. The same discussion for these areas under the black interface section also applies.

- **Low Severity Areas** (see Map 5-9 in Appendix B) - As with the black interface, these areas should be treated to prevent increased mortality from insects. However, it is important to treat the areas where the fire did not create or achieve the desired future condition. Emphasis needs to be taken to treat these lands to achieve the desired condition and maintain this condition.

**4. DFB High/Moderate Hazard/Risk Areas within Burn Perimeter** - As mentioned previously, we have been experiencing a DFB epidemic on the south half of the Forest. The fires of 2000 did not burn up our epidemic, but quite likely will make it worse in years to come.

Because DFBs are attracted to the easy prey presented by fire injured and stressed trees, and because the majority of the fire areas are mixed severity, we will likely experience an increase in beetle caused mortality. There is a potential of ending up with a stand replacing event in our current mixed severity areas due to secondary fire effects.

Active management, as proposed in this recommendation, must focus on forest conditions and not the beetle. In other words, proposed activities will not reduce the beetle populations but can reduce the amount of mortality. One approach is to alter stand conditions that favor the buildup of beetle populations using biologically sound silviculture that incorporates other resource concerns (Furniss, 1979). Thinning reduces losses to DFB for several reasons. Beetles are attracted to large, dark silhouettes and vertical cylinders (Amman, 1989). If stand conditions are altered to open up stands, still retaining the larger diameter trees, the sun is able to penetrate through the forest canopy and create subtle changes in incident radiation, temperature, light, and also wind speed (Amman, 1989). These climatic changes brought about by thinning have profound effects on tree morality from DFB (Furniss, 1979). Thinning also increases growth rates and individual tree vigor by reducing competition of sunlight, water, and nutrients; and allowing for increased growing space.

Treatment in these mixed severity types could focus on opening up stands to create a microenvironment less conducive to beetle activity. If we are to approach the desired condition, which is a reflection of the natural disturbance regime, trees other than those that are dead and/or dying will need to be removed. Green trees will

need to be harvested to approach stocking reduction levels, create structural diversity, change species composition, and increase vigor of individuals.

Options exist for reducing risk/hazard from beetles, especially DFB. Some possible treatments include:

- Incorporating a Hazard Rating – Use the hazard rating to prioritize and evaluate treatment areas.
- Sanitation/salvage – The removal of beetle-infested trees will have an indirect effect on beetle populations and associated tree mortality in burned and surrounding green areas by removing beetles from infested areas.
- Salvage of Douglas-fir – Outbreaks are typically initiated by some type of disturbance, including fire. Beetles are able to buildup in fire-injured trees and infest surrounding green trees. Removal of down, damaged, or severely weakened Douglas-fir trees is a primary means of preventing beetle outbreaks.
- Thinning – Thinning will change a stand into a condition that retards beetle population growth. The objective should be to design the thinning treatment to include activities that will increase stand resistance.
- Insecticides – These can be used to provide 1-2 years of protection against bark beetle attacks for high value trees.
- Pheromones – Pheromones can be used in aggregation or anti-aggregation.
  *Aggregation* = Can be used in various strategies, in combination with logging, to essentially contain beetle populations.
  *Anti-aggregation* = Pheromones can be used to prevent colonization by beetles and forestall population increases, which could ultimately threaten adjacent green stands.

**5. Other VRU Areas Not Previously Captured** (see Map 5-10 in Appendix B) - The treatment in these areas should focus on fuels, and where loss of productivity and land area inhibits future stand development, particularly where artificial planting is necessary.

Careful consideration needs to be made in looking at the fuels situation at a landscape scale. We have the potential to leave a legacy of extreme fuel loading on much of the burned area. As mentioned previously in this report, reburn in some VRUs is not unnatural and the focus of treatments shouldn't eliminate all reburn or fuels concerns. However, we must consider what fire suppression has done to landscape stand structures by limiting this diversity. Had we allowed fire to play its natural role, we would not be faced with this situation of a continuous landscape of potentially high to extreme fuel loadings. The take home message is that the fuel loadings at a stand level may not be unnatural; however, at the landscape level they may be.

Another twist in this discussion is the role of fire in reburns and creating non-stocked conditions in VRU 4. Historically these lands did reburn as evident from the 1910 and 1919 fires on the Lolo National Forest and others. According to Fischer and Bradley (1987) these lands often cycled through a non-stocked stage as a result of reburns where seed source was completely eliminated or competing vegetation made tree establishment difficult. From an ecological standpoint, these non-stocked conditions created as a result of reburns would be desirable. However, much of these areas are designated as commercial forest land in the Forest Plan. A determination of whether or not to treat fuels to mitigate against reburn potential will need to be weighed against ecological and social desires.

### *4.5.9.3 Vegetation Treatments Outside the Burned Area*

**Green interface** - An integrated silviculture/fuels approach in treatment of interface should be applied and use tools such as commercial entry, non-commercial entry, prescribed fire, and mechanical and/or hand treatments. Forest health, stand density reduction, and structural diversity objectives can easily be incorporated with the fuels management goals on these lands.

**Other areas outside the burn perimeter** – Priorities for vegetative treatments include VRU 2 lands where treatments are needed to meet desired conditions. Stand density reduction and creation of structural diversity at the landscape scale is needed in VRUs 3 and 4.

### *4.5.9.4 Monitoring*

**Aspen** – The purpose of aspen monitoring is to look at the fire effects on aspen stands and their response over time. This monitoring should also include mapping out the new locations of aspen as they appear. We hope to apply the knowledge learned to future restoration projects in those areas not affected by this year's fires and to gain local knowledge of the biology of Bitterroot aspen.

**Beetles** – All species of beetles associated with secondary fire effects will need to be monitored for the next 2 or 3 years to assess population status and tree mortality.

### *4.5.9.5 Research Needs*

The biggest need and largest data gap is in answering the question: how did past management practices influence the fire behavior of 2000? This includes commercial harvesting (both regeneration and intermediate), prescribed fire, precommercial thinning, and fuels treatments.

Determine the effect of the fires on Douglas-fir bark beetle populations. Douglas-fir bark beetle populations associated with secondary fire effects should be monitored for 2-3 years to assess population status and tree mortality levels.

Research is needed on the effect of the fires on aspen stands and their response over time.

Research is needed to determine how 1-0 planting stock will do on the Forest in terms of browse damage and environmental conditions. The Forest plans on using 1-0 stock to reforest the majority of the dry ponderosa pine/Douglas fir stands that were burned in 2000. Netting will not be conducted because of high maintenance costs and budget limitations. Both of these actions (using 1-0 stock and not netting) are outside of the Forest's normal process of reforestation.

Research is needed on the effect of the fires on whitebark pine stands and whitebark pine regeneration.

Research is needed to assess the potential effects of a reburn in old regeneration harvest units where broadcast burning was used for site preparation. In regenerated stands that experienced a reburn, determine the effects of the fires on site productivity.

### *4.5.9.6 Personnel Needs*

There is a need for a Forest Silviculturist for the short term to ensure that the reforestation program is being managed as well as oversight for the overall silviculture program being integrated across NEPA teams and zones. With the size of programs being proposed in addition to the enormous reforestation program we know we are going to tackle, this position is critical to the success and continuity of the silviculture organization.

There is also a need for at least one other silviculturist to assist the zone silviculturists with the planning, prescription writing, and implementation duties that are expected to increase. All fuels, burning, and vegetative treatments must be approved and reviewed by a certified silviculturist. It is expected that the current zone silviculturists, with their other responsibilities, will not be able to keep up with the prescription workload. Implementation items would include: assisting pre-sale with layout, follow-up with the marking crews, follow-up with saw crews, post-harvest examinations, etc.

There will be a need to bring on short term detailers during planting in both the spring and fall to assist with contract inspections, tree handling, driving, jelly rolling, etc. With the size of program we are planning for, the current organization will not be able to handle the workload.

In addition, detailers will be needed in the future to accomplish critical projects such as: pre-planting examinations, stocking surveys, cone collections, stand redelineation, database upkeep and reporting, etc.

## 4.5.10 Recommendations: Selway and Salmon River Drainages

Two general recommendations concisely summarize the vegetation restoration themes for this analysis area:

1. Restoration of landscape and plant community composition, structure and function through restoration of natural disturbance regimes.

2. Restoration of plant community and genetic integrity through control of non-native species and revegetation with native plant species from locally adapted sources.

More specific recommendations of these general themes that reflect the highest priorities at this scale include:

- High elevation forests have been most markedly affected by the decline of whitebark pine and alpine larch. Inventory whitebark pine for condition and trend in areas where active restoration can occur. Fire scenarios best adapted to maintain or regenerate whitebark pine and alpine larch based on its condition and threats should be continued. This information should be used to develop wildland fire use prescriptions. If there are whitebark pine stands that appear to have developed any rust resistance, collection of seed should be considered if cost effective. This seed could be used to provide planting stock for areas where planting is appropriate inside or outside the wilderness. There is some concern with wildland fire being used and not achieving goals due to more mortality in whitebark pine than desired. This is particularly the situation where large polygons of lethal fire have eliminated most or the entire live whitebark pine seed source. This is undesirable from a restoration standpoint. There is a fine line between those fires that are desired and those that are not. Therefore, there is a need to analyze past fire behavior to determine if increased use of wildland fire can be supported.

- Low elevation dry and moderately moist forest has been impacted by fire exclusion; with consequent increases in stand density, multi-layered stands, and increases in grand fir and Douglas fir. There is a need to allow natural fire to continue in these forests to provide structural and compositional diversity across the landscape. However, necessary analysis to support expanded wildland fire use in appropriate areas is needed due to the wide scale Douglas-fir bark beetle outbreak we have been experiencing for the last four years and expected to further expand as a result of many thousands of acres of fire-stressed trees. Putting out natural fires to mitigate the Douglas-fir beetles may or may not be an option, but should be considered

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# Appendix A. Photos

**Figure 5-3.** Example of Douglas-fir encroachment under an overstory of ponderosa pine in VRU 2.

**Figure 5-4** Lethal or stand replacement fire in VRU 2.

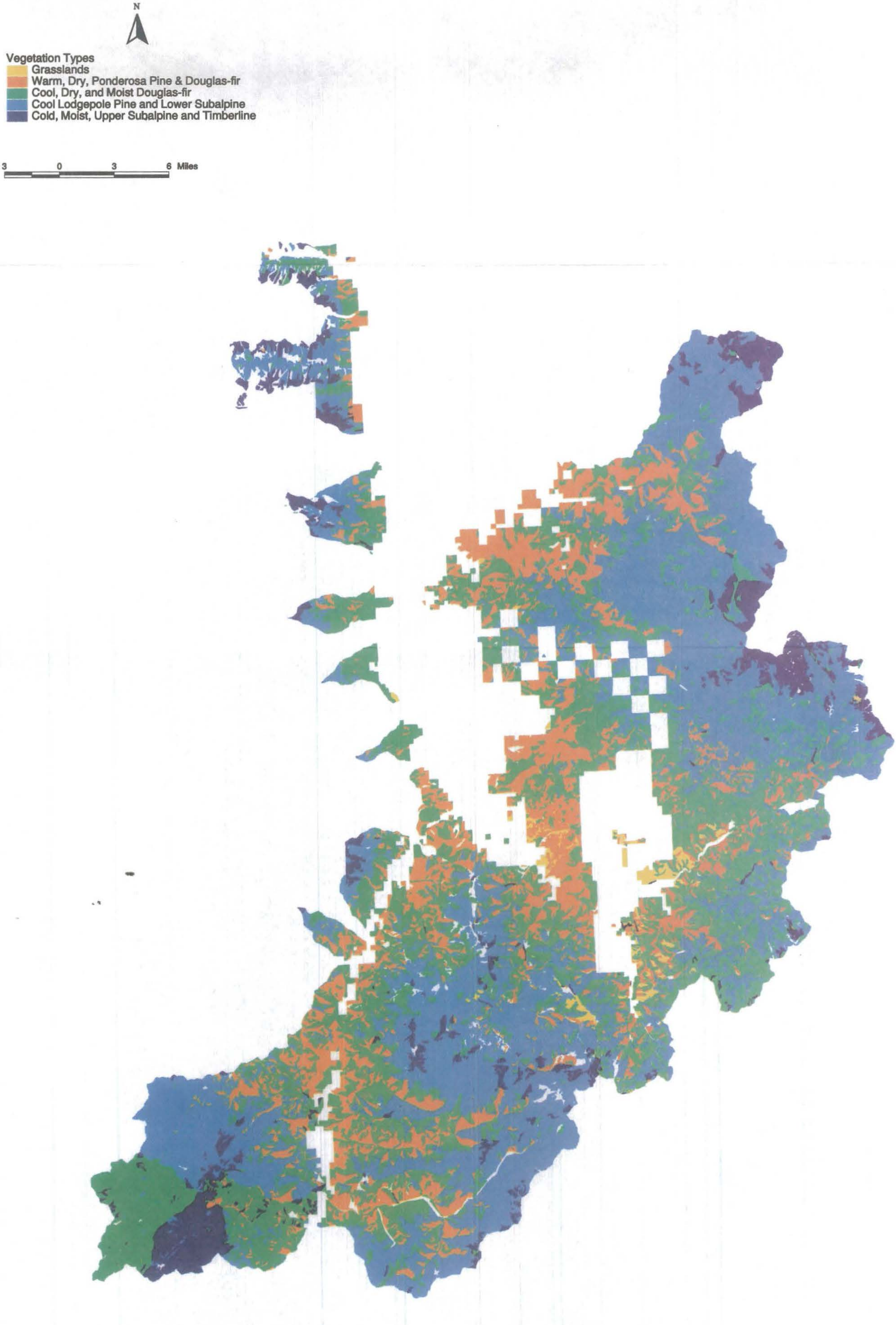
**Figure 5-5**. Example of mixed severity fire in VRU-3.

**Figure 5-6**. Example of fire intensities in VRU 4.

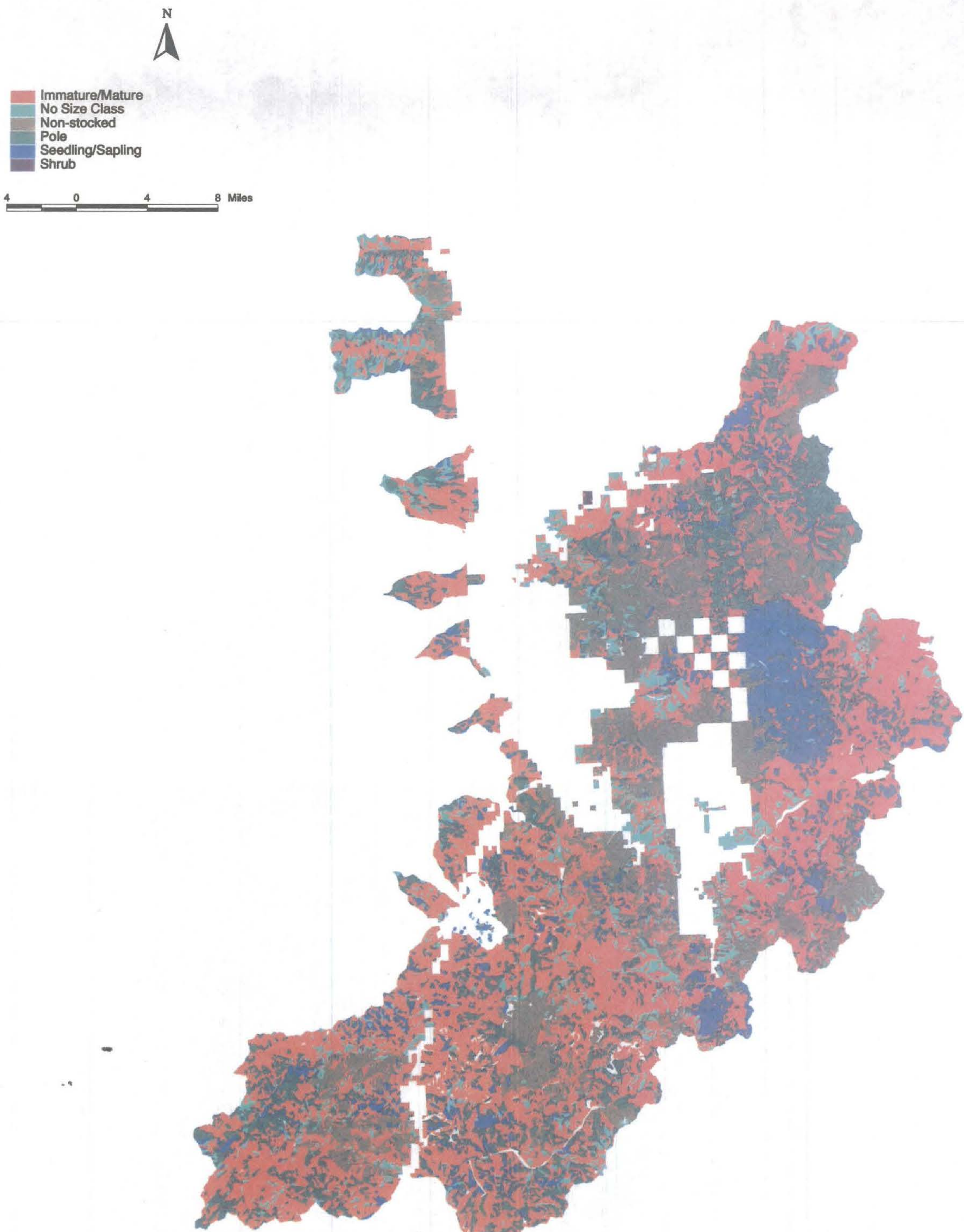
**Figure 5-7.** Root rot pockets just west of Magruder Mountain in the Frank Church Wilderness.

**Figure 5-8.** Lethal or stand replacement fire in a ponderosa pine plantation.

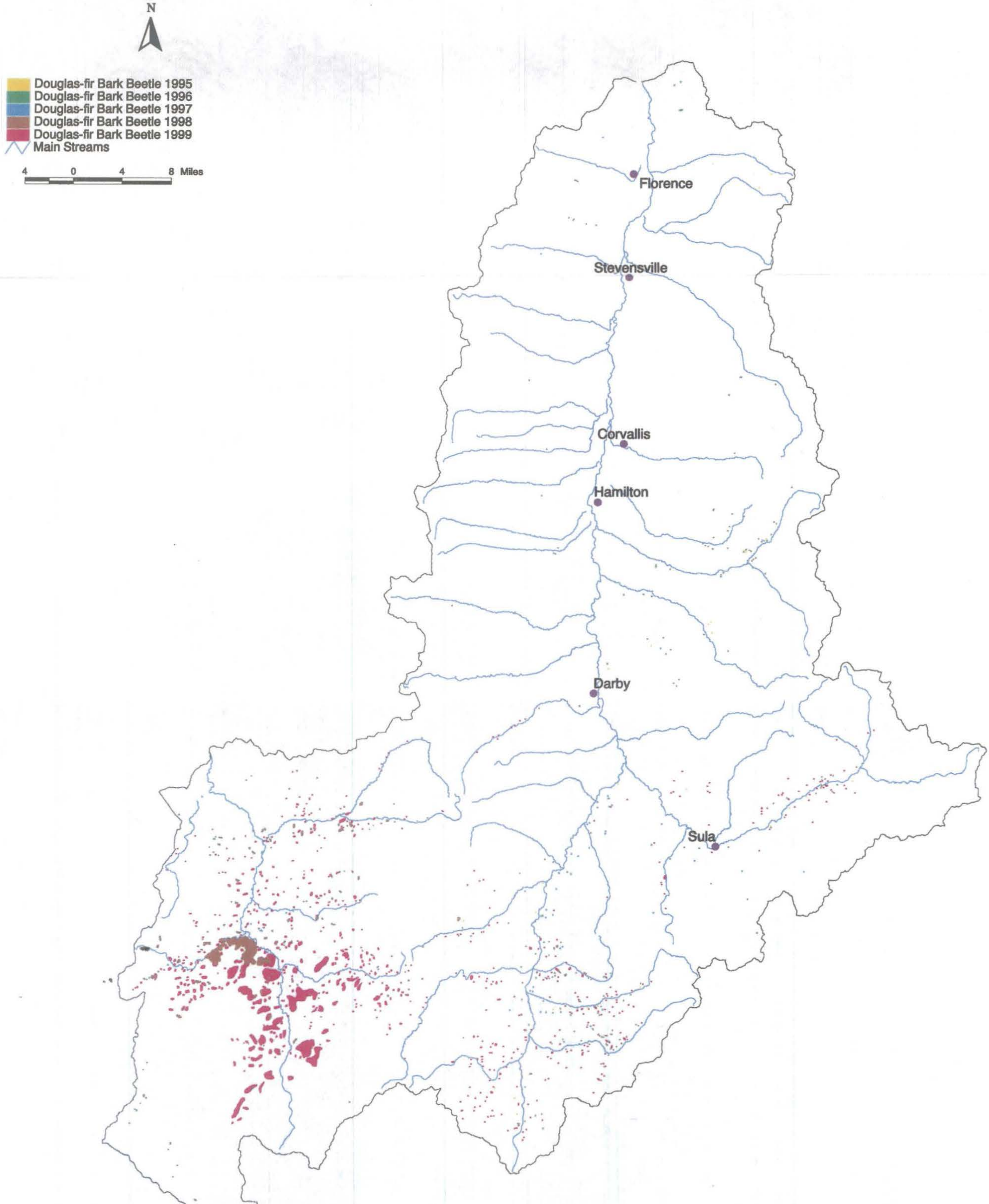
## Map 5-1: Vegetative Response Units



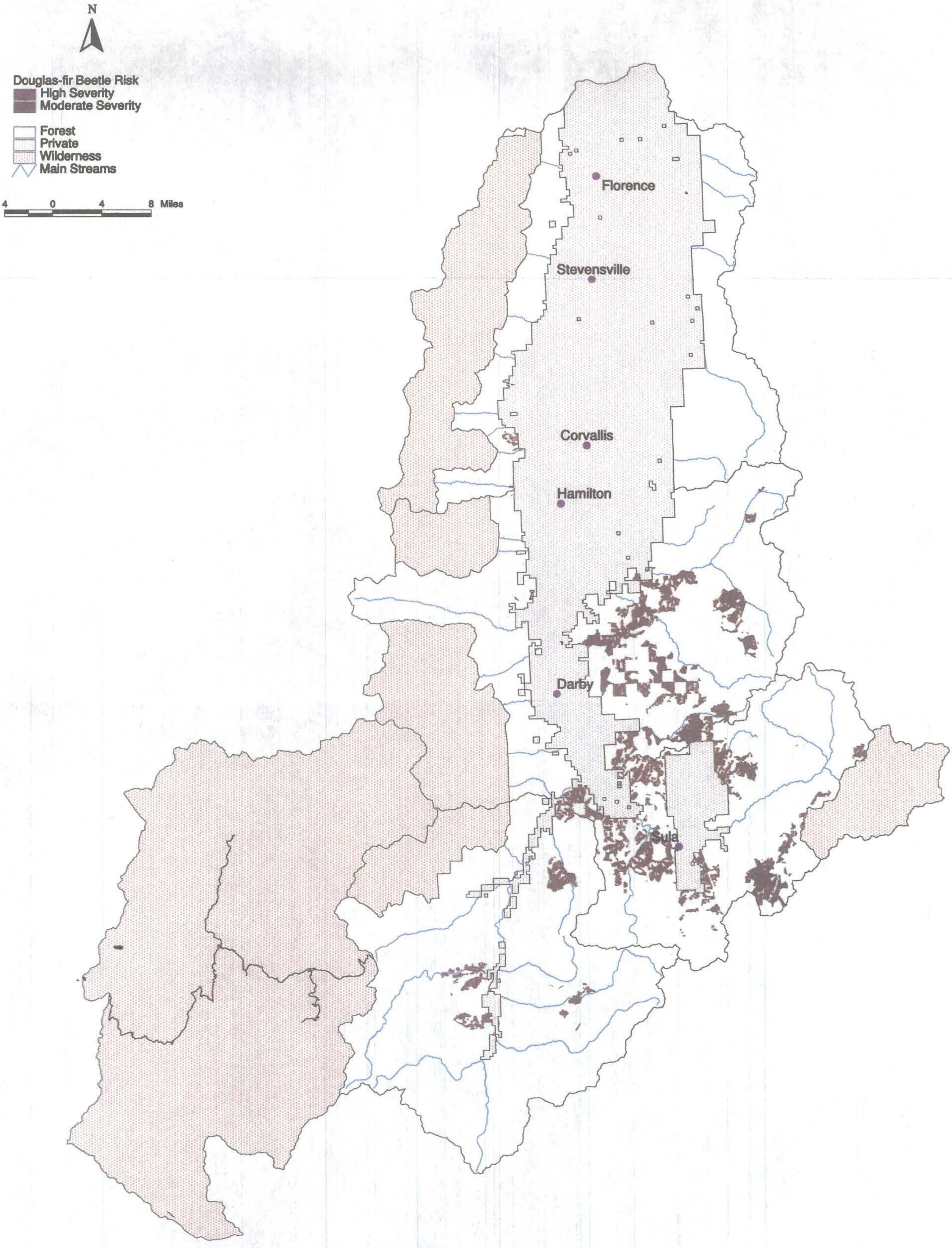
Map 5-2: Post-fire Stand Structure



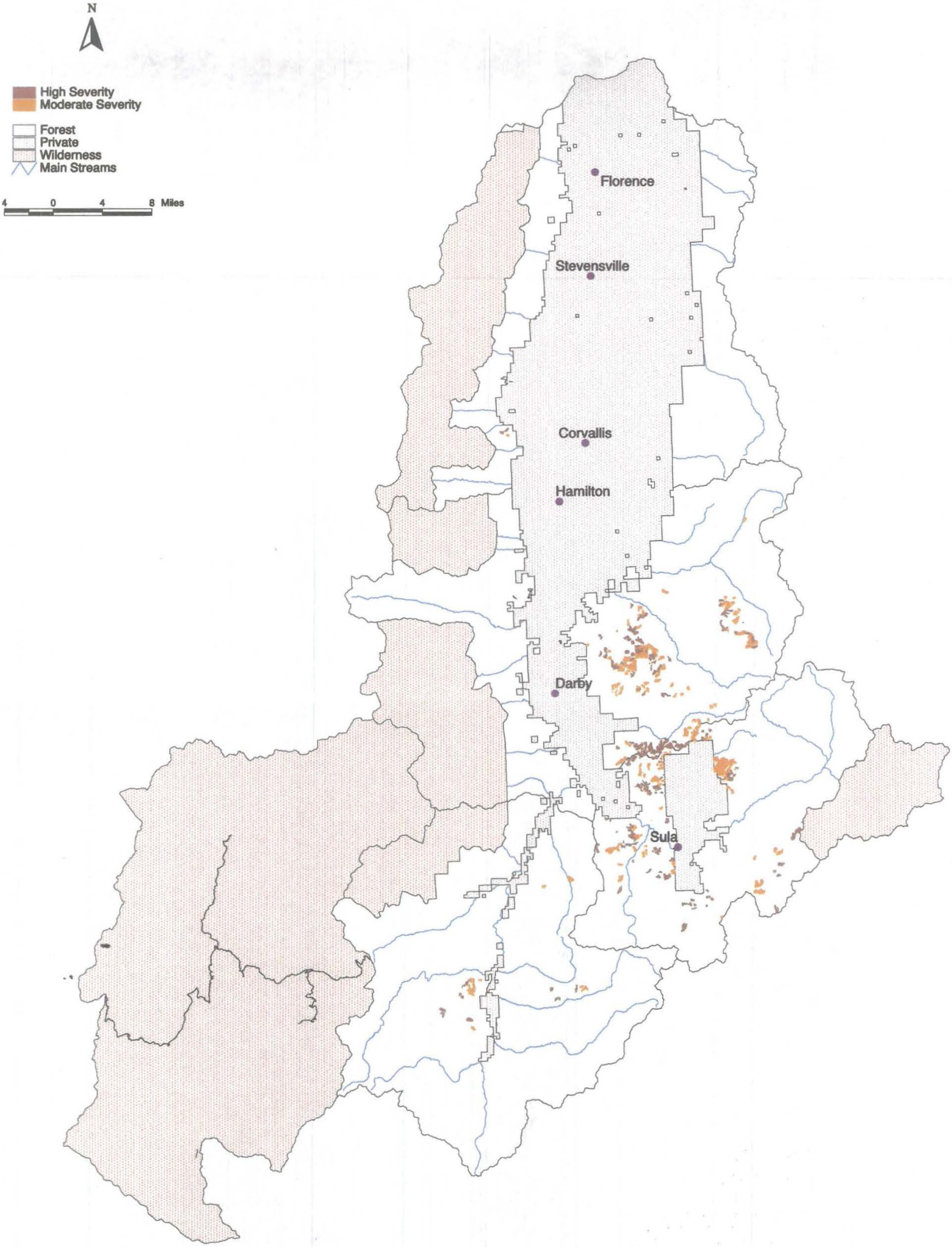
Map 5-3: Douglas-fir Bark Beetle Populations For The Last Five Years



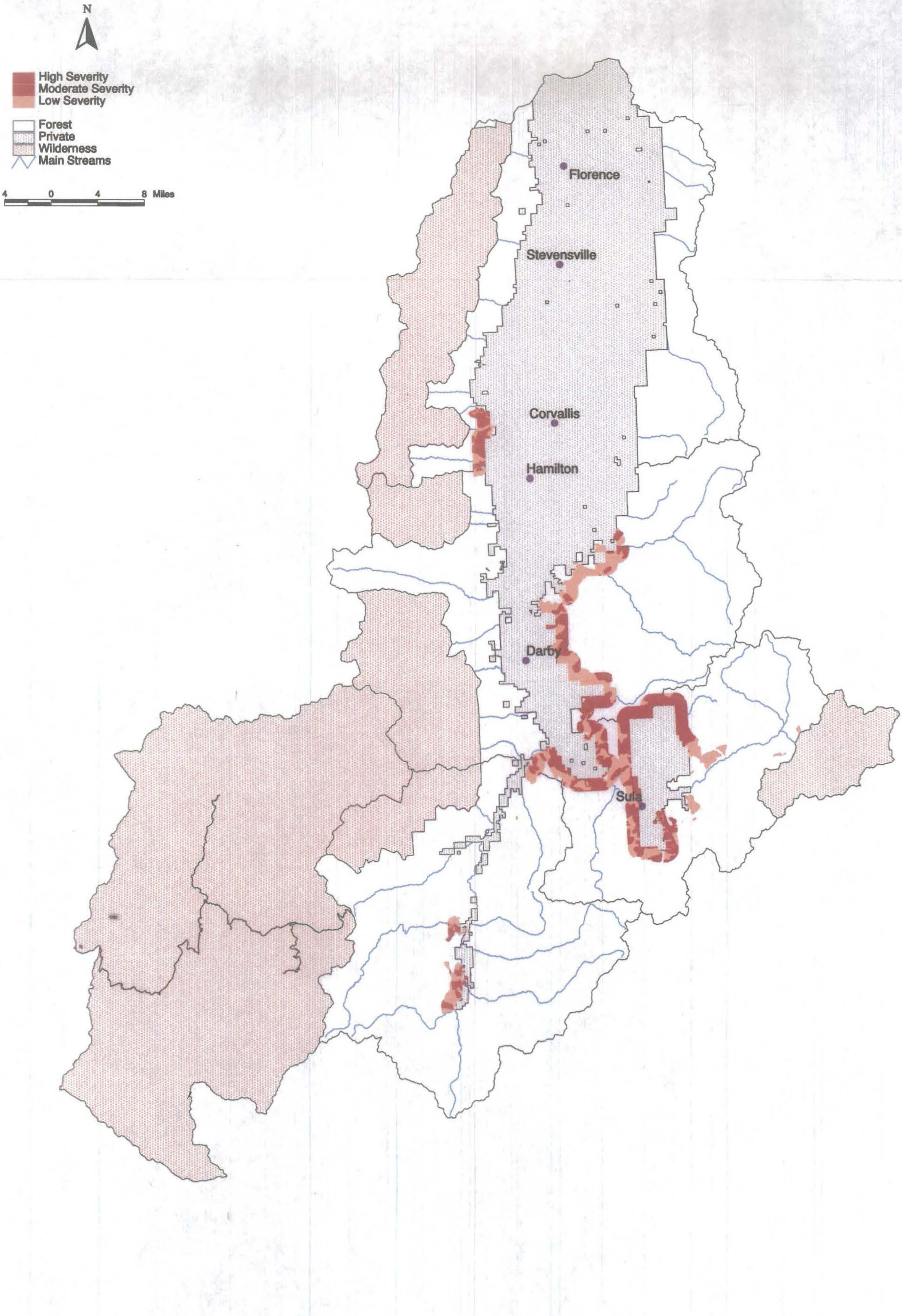
Map 5-4: Douglas-fir Bark Beetle Hazard Rating



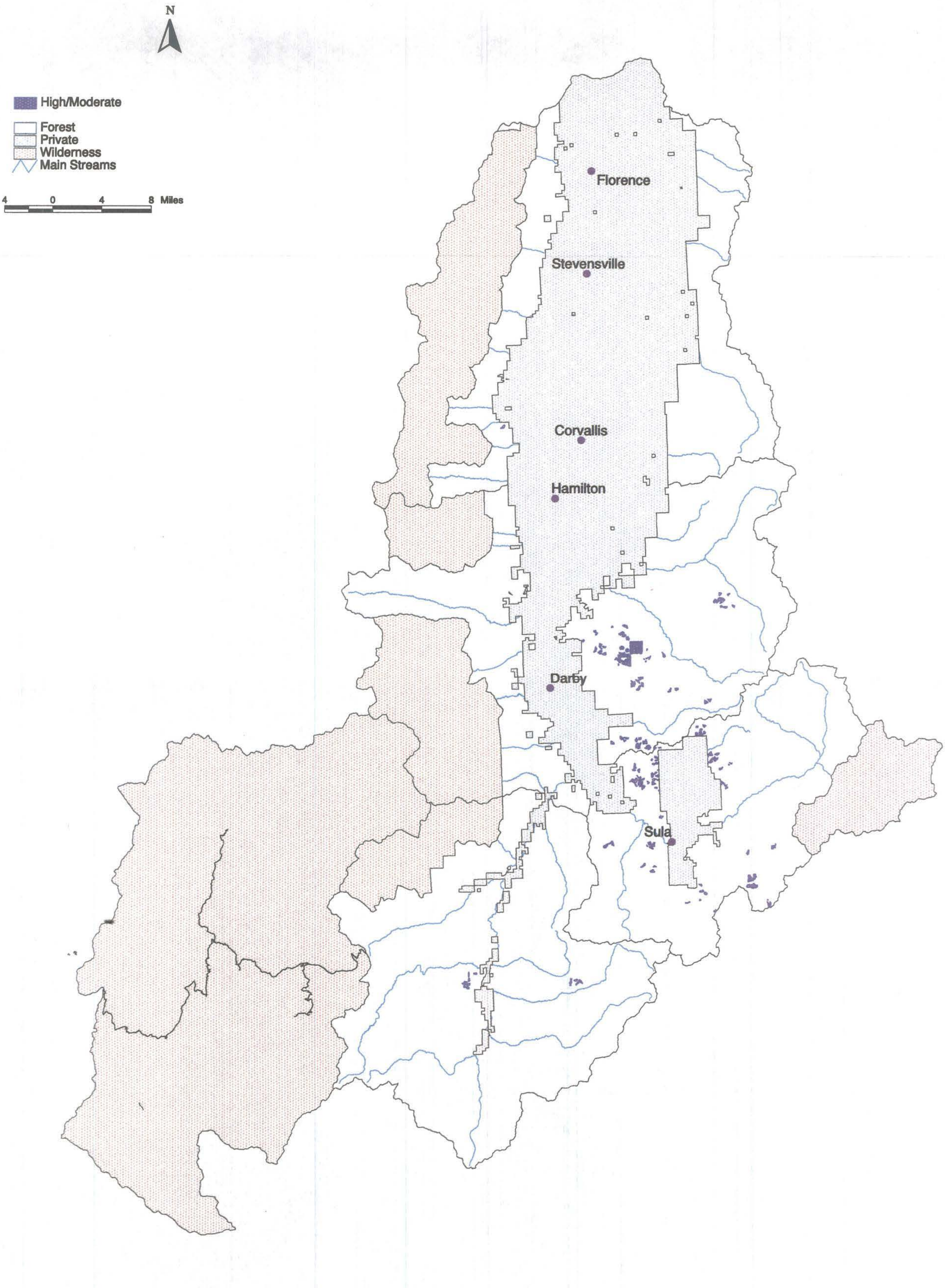
Map 5-5: Past Regeneration Harvests Burned With High Or Moderate Severity



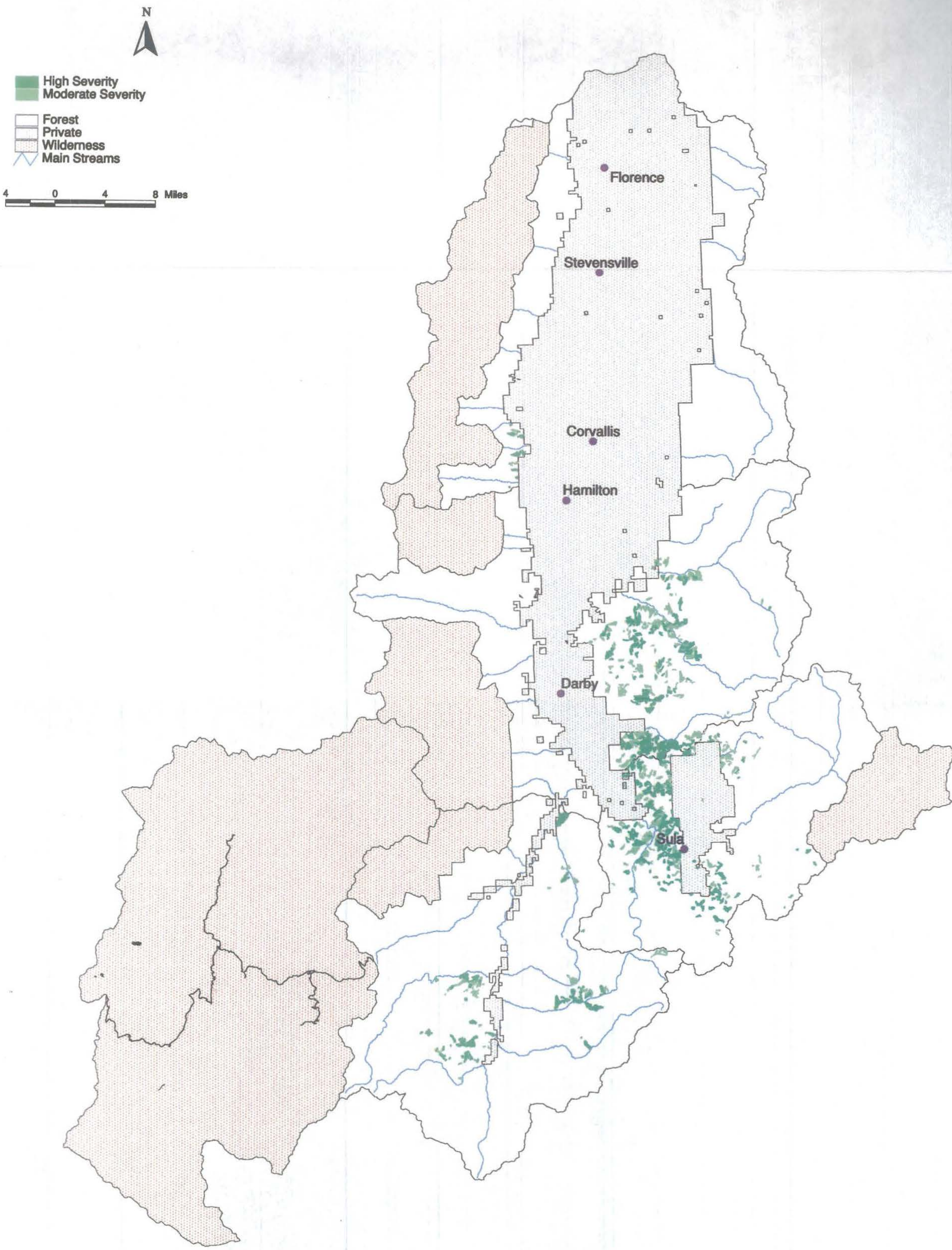
Map 5-6: Areas Within The Burned Interface



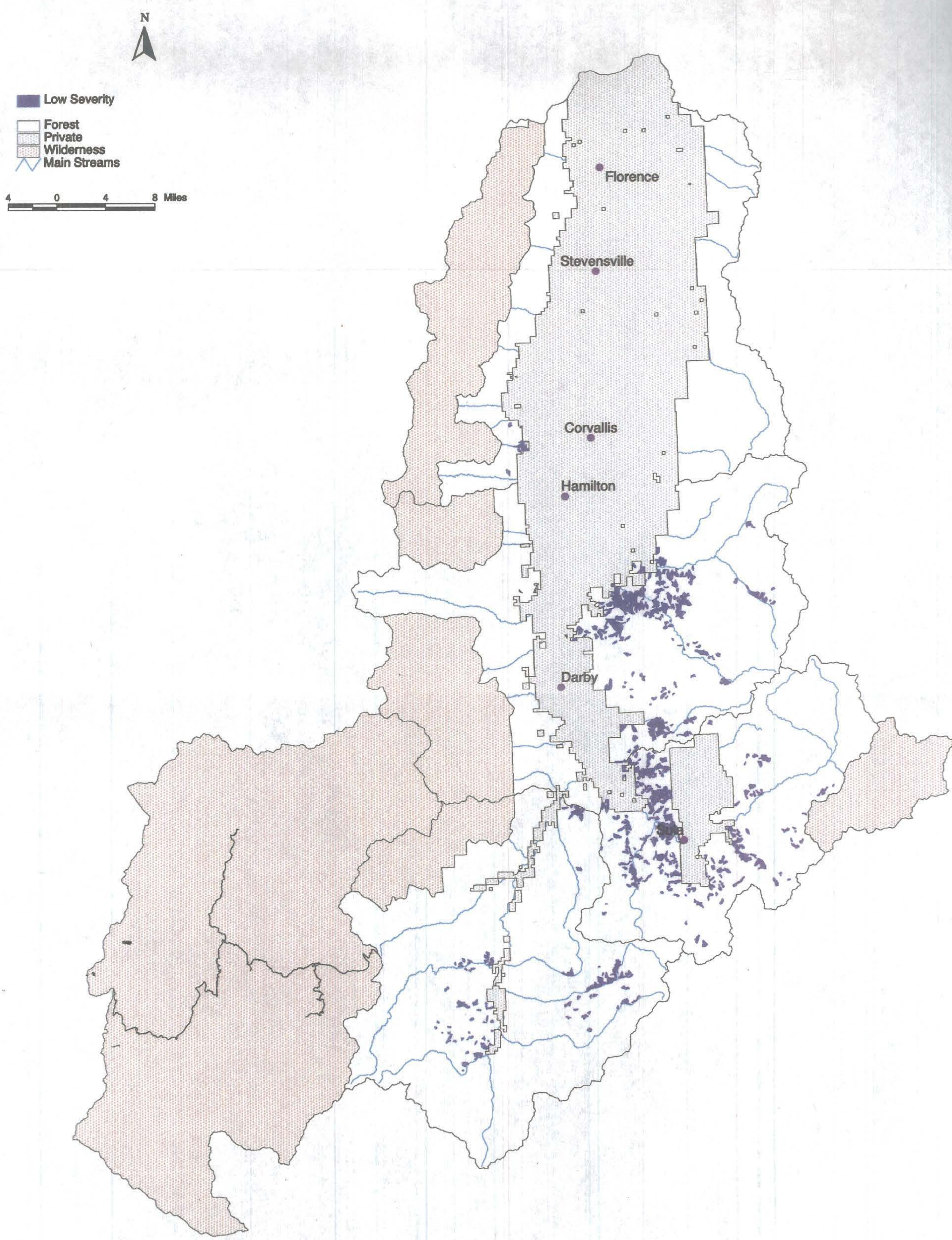
## Map 5-7: Treatment Of Fuels In Past Regeneration Harvest Units Less Than 20 Years Of Age With High/Moderate Severity



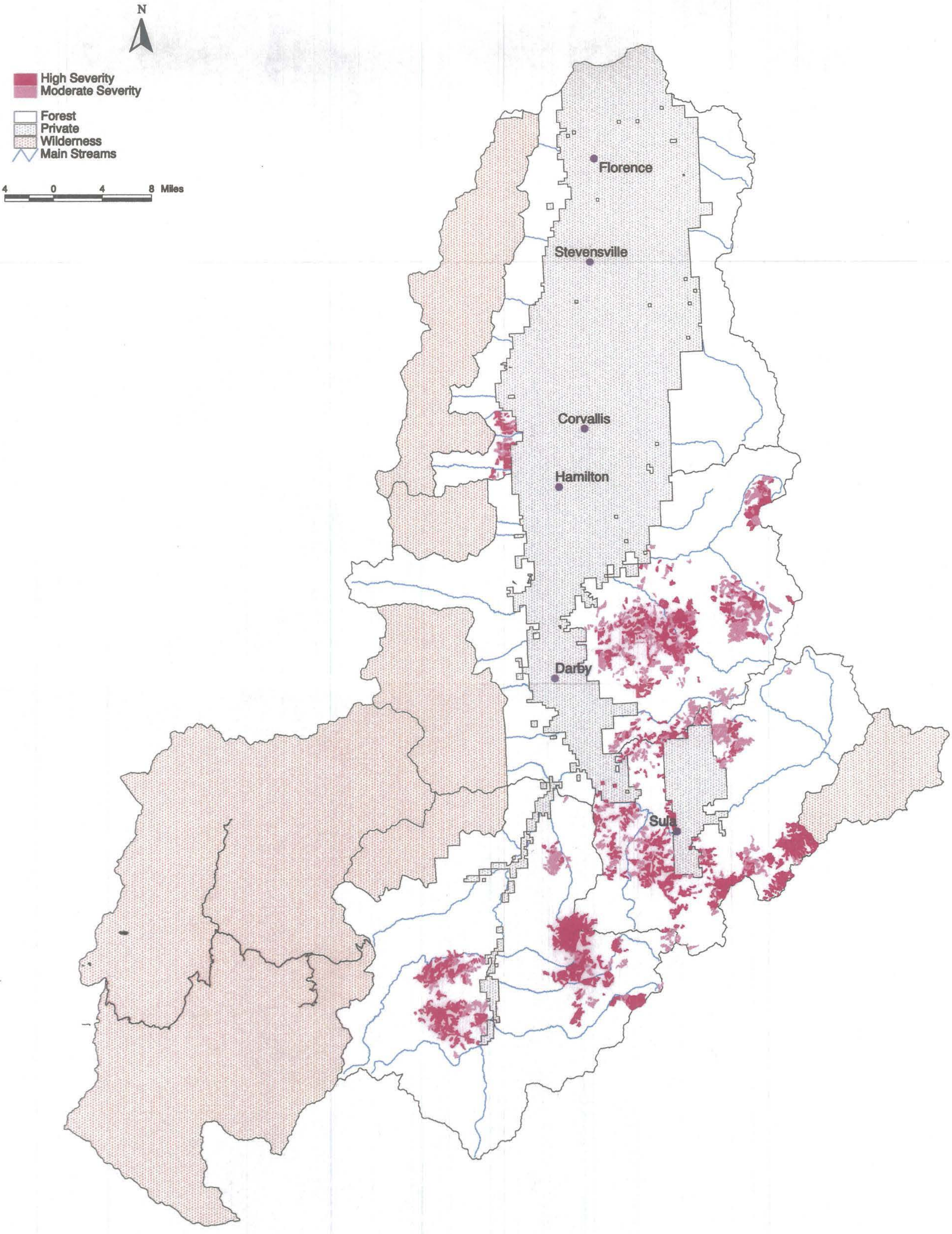
## Map 5-8: Areas Within VRU 2 OF High/Moderate Severity



Map 5-9: Areas Within VRU 2 OF Low Severity



## Map 5-10: Areas Within VRU 3 And 4 Of High/Moderate Severity



# 4.6 Forest Products

## 4.6.1 Background

The Bitterroot National Forest is 1,580,550 acres in size, where 92 percent is forest land and 8 percent non-forest or water. The most common forest type on the Bitterroot is Douglas-fir covering 43 percent of the forest land area. Following in order of abundance is spruce – f at 22 percent; lodgepole pine at 18 percent; ponderosa pine at 9 percent; whitebark pine at 3 percent; larch at 2 percent, and grand fir at 1 percent.

Wood production is one of many important uses of non-reserved forest land on the Bitterroot National Forest. This is land that is not withdrawn from timber utilization through statute or administrative designation. It amounts to approximately 798,449 acres or 55% of the total forest land on the Bitterroot forest. About 60 percent of the non-reserved forest land is considered to be suitable for timber production (USDA 1987).

The volume of saw timber on suitable lands is estimated to be over 3.8 billion board feet (Scribner rule). Douglas-fir accounts for about 56 percent of the total volume on suitable lands, while the other primary commercial tree species, lodgepole pine, ponderosa pine, subalpine fir, and engleman spruce, cover the remaining 44 percent of the timber volume.

The logging and mining history in the Bitterroot Valley date back to the late 1800's after the arrival of the railroad. Large tracts of land in the Bitterroot Valley were logged by the 1890's and by 1930, 22 percent of the area had been logged.

Timber harvest in the Bitterroot valley has changed shape over recent years as saw mills have closed and the amount of available timber has decreased. Other forest product industries, house log and value added products, are showing variable degrees of growth. It would be difficult to predict what will happen to the timber industry in the Bitterroot Valley in the years ahead. Although, it is safe to assume that the forest products industry, to some extent, will always factor into the local economy as well as contribute toward maintaining healthy forests in the Bitterroot.

## 4.6.2 Issues

- How should the Bitterroot National Forest proceed with salvaging timber and other commercial products after the fires? What options are there for product removal? What are the limitations?

- Should temporary roads be constructed for harvesting stands not accessible from system roads?

- How should the Bitterroot National Forest administer a personal use forest product program after the fires?
- What is the anticipated value and volume loss to the timber resource and how will that affect any opportunities for salvage harvest over the next 1 to 5 years?
- What steps should the Bitterroot National Forest take toward initiating a mushroom management program after the fires?

## 4.6.3 Historic and Pre-fire Conditions

The Interior West Resource Inventory, Monitoring and Evaluation (IWRIME) Program of the Rocky Mountain Research Station, inventoried the timber resource on the Bitterroot National Forest prior to the fire season of 2000. (USDA Forest Service, 2000). One of the outcomes of this effort is a summary of the numbers of each tree species by size class, specific to this forest.

| | Trees (in millions) 1.0 - 6.9" diameter | Trees (in millions) 7.0 and greater |
|---|---|---|
| Subalpine fir | 160 | 20 |
| Douglas-fir | 115 | 50 |
| Lodgepole Pine | 105 | 50 |
| Whitebark Pine | 35 | 5 |
| Engelman Spruce | 15 | 7 |
| Ponderosa Pine | 10 | 8 |
| Grand fir | 7 | 6 |
| Larch, Aspen, Mtn. Maple, Subalpine Larch | < 2 | < 1 |

This information may be useful when comparing the pre-fire condition of the commercial and non-commercial timber resource loss due to the fires of 2000.

There is 150,000 acres of suitable forest land that burned during the fire season of 2000, and 50 percent of that area burned in a stand replacing fashion. In addition, gross annual growth of growing stock trees on suitable forest land is estimated at 19 million cubic feet. On the same lands, mortality is estimated to be 2.8 million cubic feet annually, or about 15percent of the gross annual growth in growing stock trees. Additional mortality, beyond what would be considered normal for the Bitterroot, is expected to occur later on from insects and disease.

The commercial value of the timber resource consumed by the fire would have received the highest possible appraised monetary value. This situation would have existed

because of the live condition of the trees, and the appraised value for the live commercial timber.

Commercial or personal use morel mushroom harvesting was not a concern on the Bitterroot National Forest before the fires of 2000. Some incidental harvesting may have occurred in isolated areas of the forest up until this time. The spring of 2001 may reveal an entirely different situation relating to this plant and the role it plays in our social and economic lives. If the biotic and climatic conditions for the natural production of morels are available this spring and summer, it is likely that interest in this forest product may grow at an unprecedented rate. For the purpose of this report, an action plan has been developed to assist the Forest in making a decision on how to proceed with a management plan for large scale mushroom harvesting – personal or commercial use. Refer to Appendix A for this information.

## 4.6.4 Effects and Implications of the Fires of 2000

For the purpose of forest products, the current conditions can be expressed in terms of the amount of area affected and the estimated damage to the timber resource that occurred during the fires 2000. Each geographic analysis area is unique in this regard, and the data displayed in the following tables will illustrate those effects.

Wood fiber deterioration will begin to occur after July 2001. This change will bring on a definite loss in tree volume and market value over the next 1 to 4 years. Ponderosa pine will experience wood devaluation in the market the soonest because of bluing and top wood volume loss. Douglas-fir and sub alpine fir will deteriorate progressively as a result of sap rot, with the greatest loss occurring in the smaller commercial size class (7.0 to 11 inches diameter) first. lodgepole pine and other whitewoods are likely to experience a slower rate of deterioration. This is especially true where dead lodgepole pine meet dead *saw log* specifications. Dead lodgepole pine that meet *house log* specifications will be affected the least except where severe damage occurred to this product from the fire. The basis for selling dead lodgepole pine saw logs or house logs is on gross volume and value.

Forest product opportunities appear more abundant now, largely due to the change in the forest conditions after the fires. Bitterroot Valley residents have expressed a strong interest in utilizing certain forest products for both personal and commercial use. Forest products that may be available from fire areas are: commercial saw logs, house logs, biomass, firewood, mushrooms, and other character wood for landscaping. Personal use forest product opportunities may also be available for mushroom and firewood gathering. A large supply of dead and dying lodgepole pine and Douglas-fir will make personal and potential commercial use firewood opportunities available for several years following the fires.

Current lumber market trends, tree deterioration, and available wood processing facilities may conflict with future proposed actions. Today, the lumber market is experiencing a decline in economic pricing (August, September, October 2000), stemming from an oversupply of wood product materials. Many companies have suffered profit losses as a result of this recent downward trend. In addition to the recent decline in lumber prices, lumber companies need to limit shift hours or implement temporary shutdowns in order to survive the lower market prices. This market-related challenge exists over and above the longer-term problems that have existed in the Northwest timber industry through the past decade and led to permanent mill shut downs. Fewer lumber milling facilities, high value appraisals/lower lumber prices, and other agency or private land owner timber sales may temporarily saturate the local log market, and potentially impact any forest product proposals on the Bitterroot National Forest. Those impacts are not obvious at this time, but it is reasonable to assume that all or some of those factors may weigh into industry's decision to respond to public timber sale offerings.

To illustrate one way in which timber harvesting is occurring locally, the Montana Department of Natural Resources and Conservation (DNRC) timber sales totaling approximately 35 million board feet on the Sula State Forest. These sales will salvage trees that were burned by the fires of 2000. The projects will emphasize the removal of trees damaged by the fire and not include live trees or fire-stressed trees. The first of the DNRC timber sales commenced in December, 2000.

### *4.6.4.1 Burned Acres*

### *4.6.4.2 Timber Volume Loss by Geographic Area*

**Blodgett Analysis Area**

***Table 6-1. Summary of acres by management area, fire severity and road status***

| Management areas | Burned area - All fire severity - Roaded | Burned area - All fire severity - Not roaded | Percent of area burned |
|---|---|---|---|
| 3 | 1,074 acres | 893 acres | 16 |
| 5 | 0 acres | 1,828 acres | 33 |
| 6, 7 | 0 acres | 6317 acres | 51 |

More than half of this geographic area burned in areas that are managed for existing wilderness or recommended wilderness uses. Within management areas 1, 2, and 3, prior harvest activities totaled 29 acres of intermediate harvest and 72 acres of regeneration harvesting. Burn severity acreage percentages are: 69 percent under the high/moderate and 31 percent for low severity in the roaded, commercial forestland.

The following table displays the estimated loss of timber resource volume, expressed in thousands of board feet (mbf), for the Blodgett analysis area. The information is separated by land containing roads or no roads and the commercial or non-commercial timber land as described in the Bitterroot Forest Plan.

***Table 6-2. Estimated loss of volume to the timber resource in the Blodgett Analysis Area***

| **Roads ------- No Roads** | **Commercial Forest Land - Board foot volume loss (MAs 1, 2, 3)** | **Non-Commercial Forest Land - Board foot volume loss (MAs 5, 6, 7, 8)** | **Total volume (mbf)** |
|---|---|---|---|
| Roaded | 5,517 mbf | 7,898 mbf | 13,415 |
| Not roaded | 6,103 mbf | 16,880 mbf | 22,983 |
| Total | 11,620 mbf | 24,778 mbf | **36,966** |

## East Fork Analysis Area

***Table 6-3. Summary of acres by MA, fire severity and road status***

| **Management Areas** | **Burned area - All fire severity - Roaded** | **Burned area - All fire severity - Not roaded** | **Percent of area burned** |
|---|---|---|---|
| 1, 2, 3 | 52,212 acres | 7,897 acres | 72 % |
| 5, 8 | 5,961 acres | 11,237 acres | 21 % |
| 6, 7 | 0 acres | 5,619 acres | 7 % |

In the roaded portion of this analysis area, an estimated 15,174 acres were harvested and regenerated and an additional 659 acres of intermediate harvest occurred prior to the fires. Conventional ground-based and cable harvesting equipment was used in this analysis area. Forest Service system roads are adequate for log hauling and timber salvage harvesting.

***Table 6-4. Estimated loss of volume to the timber resource in the East Fork Analysis Area***

| **Roads ------- No Roads** | **Commercial Forest Land - Board foot volume loss (MAs 1, 2, 3)** | **Non-Commercial Forest Land - Board foot volume loss (MAs 5, 6, 7, 8)** | **Total volume (mbf)** |
|---|---|---|---|
| Roaded | 234,645 mbf | 47,476 mbf | 282,121 |
| Not roaded | 65,620 mbf | 45,652 mbf | 111,272 |
| Total | 300,265 mbf | 93,128 mbf | **393,393** |

## West Fork Analysis Area

***Table 6-5. Summary of acres by MA, fire severity and road status***

| Management areas | Burned area - All fire severity Roaded | Burned area - All fire severity Not roaded | Percent of area burned |
|---|---|---|---|
| 1, 2, 3 | 14,695 acres | 11,948 acres | 56 % |
| 5, 8 | 900 acres | 19,115 acres | 43 % |
| 6, 7 | 0 acres | 52 acres | 1 % |

In the roaded portion of this analysis area, there are an estimated 1,333 acres that were harvested and regenerated prior to the fires, and an additional 1889 acres of intermediate harvest as well. Conventional ground based, cable logging, and helicopter harvest systems were utilized in this analysis area prior to the fires of 2000.

***Table 6-6. Estimated loss of volume to the timber resource for West Fork Analysis Area***

| Roads ------- No Roads | Commercial Forest Land - Board Foot Volume Loss (MAs 1, 2, 3) | Non-Commercial Forest Land - Board Foot Volume Loss (MAs 5, 6, 7, 8) | Total Volume (mbf) |
|---|---|---|---|
| Roaded | 96,379 mbf | 4,262 mbf | 100,641 |
| Not roaded | 24,990 mbf | 73,076 mbf | 98,066 |
| Total | 121,069 mbf | 77,338 mbf | **198,707** |

## Rye – Sleeping Child – Skalkaho Analysis Area

***Table 6-7. Summary of acres by MA, fire severity and road status***

| Management areas | Burned area - All fire severity - Roaded | Burned area - All fire severity - Not roaded | Percent of area burned |
|---|---|---|---|
| 1, 2, 3 | 47227 acres | 13049 acres | 75 % |
| 5, 8 | 404 acres | 19864 acres | 25 % |
| 6, 7 | 0 acres | 0 acres | NA |

***Table 6-8. Estimated loss of volume to the timber resource for Rye – Sleeping Child – Skalkaho Analysis Area***

| **Roads<br>-------<br>No Roads** | **Commercial Forest Land - Board foot volume loss (MAs 1, 2, 3)** | **Non-Commercial Forest Land - Board foot volume loss (MAs 5, 6, 7, 8)** | **Total volume (mbf)** |
|---|---|---|---|
| Roaded | 276039 mbf | 1608 mbf | 277647 |
| Not roaded | 109535 mbf | 63084 mbf | 172619 |
| Total | 385,574 mbf | 64,692 mbf | **450266** |

### *4.6.4.3 Expected Decline in Timber Volume Over a 5-year Period*

Douglas fir

Assumptions:

- Loss of top wood volume to dry-checking and wind damage
- Sap rot
- High rate of early volume and value loss in the smaller diameter classes
- *Wood deterioration from flathead woodborers.

* If flathead woodborers enter the fire-damaged Douglas-fir stands, trees may experience more rapid deterioration in all size classes prior to 2003.

***Table 6-9. Expected decline in Douglas-fir volume by diameter – 5 years***

| **Diameter class** | **Percent of trees** | **Trees per acre** | **Board foot volume per tree** | **Volume per diameter class (mbf/ac)** |
|---|---|---|---|---|
| 7" – 11" | 55 | 77 | 40 | 3.1 |
| 12" – 18" | 35 | 49 | 100 | 4.9 |
| 18"+ | 10 | 14 | 220 | 3.1 |
| **Total** | | | | **11.1** |

***Table 6-10. Percent expected board foot volume decline in Douglas-fir by diameter over next 5 years*** *(does not include natural defect)*

| Diameter class | 7/2001 | 7/2002 | 7/2003 | 7/2004 | 7/2005 |
|---|---|---|---|---|---|
| 7" – 11" | 15% | 60% | Cull | ---- | ---- |
| 12" – 18" | 10% | 20% | 50% | 75% | Cull |
| 18"+ | 10% | 20% | 40% | 65% | Cull |

**Ponderosa Pine**
Assumptions:

- Loss of top wood volume due to dry-checking and wind damage.

There will be fewer pulp chips available from saw log trees. This is likely to occur particularly in the "bull pine" whenever a fire is hot enough to deeply char the knots and limbs of the tree. This is more of an economic issue that affects the industry and not the Forest Service. Give consideration to this issue when evaluating appraised value.

Tree discoloration (bluing) will begin in 7/2001 or sooner. Early bluing is not recognized as a defect, although logs are degraded when they contain blue stain, whether or not they are defective. Tree volumes and value loss will occur in the smaller size ponderosa pine the earliest.

Consider increasing the minimum diameter specification for ponderosa pine. This will lessen the potential for overestimating board foot volumes. Undersized material will make good coarse woody debris replacement in areas where that is a consideration.

***Table 6-11. Expected decline in ponderosa pine volume by diameter – 5 years***

| Diameter class | Percent of trees | Trees per acre | Board foot volume per tree | Volume per diameter class (mbf/ac) |
|---|---|---|---|---|
| 7" – 11" | 60 | 90 | 35 | 3.1 |
| 12" – 15" | 25 | 38 | 65 | 2.5 |
| 16" – 21" | 10 | 15 | 175 | 2.6 |
| 21" plus | 5 | 7 | 290 | 2.0 |
| **Total** | | | | **10.2** |

***Table 6-12. Percent expected board foot volume decline in ponderosa pine by diameter over next 5 years** (does not include natural defect)*

| Diameter class | 7/2001 | 7/2002 | 7/2003 | 7/2004 | 7/2005 |
|---|---|---|---|---|---|
| 7" – 11" | 15% | Cull | ---- | ---- | ---- |
| 12" – 15" | 8% | 20% | 75% | Cull | ---- |
| 16" – 21" | 5% | 18% | 45% | Cull | ---- |
| 21"+ | Natural | 15% | 35% | 55% | Cull |

**Lodgepole Pine**

Assumptions:

- Loss of top wood and lower bole volume due to dry-checking and wind damage.

Dead lodgepole pine usually makes excellent saw log trees long after the tree is dead, but for many stands this may not be possible unless the tree diameter at breast height and top diameter inside bark are sufficient in size to meet utilization requirements. Bark slippage is likely to happen sooner than is usually expected in the fire-damaged stands and lower bole checking (affecting utilization) will occur soon afterward.

Lodgepole pine trees that meet house log specifications are likely to last the longest after the fire. The percent decline in board foot volume displayed in the following table represents the loss to the sawtimber component. It is safe to assume that the majority of the high-defect and culled material appearing in the larger diameter classes can be recouped by marketing house logs instead.

***Table 6-13. Expected decline in lodgepole pine volume by diameter – 5 years***

| Diameter class | Percent of trees | Trees per acre | Board foot volume per tree | Volume per diameter class (mbf/ac) |
|---|---|---|---|---|
| 6" – 9" | 75 | 150 | 55 | 8.2 |
| 10" – 13" | 23 | 46 | 85 | 3.9 |
| 13"+ | 2 | 4 | 140 | .6 |
| **Total** | | | | **12.7** |

***Table 6-14. Percent expected board foot volume decline in lodgepole pine by diameter over next 5 years*** *(does not include natural defect)*

| Diameter class | 7/2001 | 7/2002 | 7/2003 | 7/2004 | 7/2005 |
|---|---|---|---|---|---|
| 6" – 9" | 15% | 50% | Cull | ---- | ---- |
| 10" – 13" | 10% | 10% | 32% | Hs log | Hs log |
| 13"+ | 10% | 10% | 32% | Hs log | Hs log |

## 4.6.5 Objectives and Recommendations

The information on volume and acres that appears in these recommendations provide data for the burned area treatment priorities in Section 5.5 (Forested Plant Communities) of this document. This should not imply that these volumes of fire killed timber should be or are necessarily intended to be harvested. This data is provided as one piece of information to be considered in evaluating management options. Existing transportation system road access, visual sensitivity, other resources, non-timbered areas, and prior regeneration/intermediate harvest units are all factored into this assessment to arrive at responsible estimates of timber volume.

### *4.6.5.1 East Fork Analysis Area*

**Vegetative Treatment Priority 1.**

***Table 6-15. Accessible mortality in wildland-urban interface, East Fork***

| Fire Severity Class | Acres 70% Accessible | Mortality Volume (mmbf) |
|---|---|---|
| High/Moderate | 8,258 | 66 |
| Low | 7,728 | 27 |
| **Total** | **15,986** | **93** |

**Vegetative Treatment Priority 3.**

***Table 6-16. Estimated mortality in VRU 2 – moderate and high severity burns, East Fork***

| | High-mod. severity acres | High-mod severity volume (mmbf) | Low severity acres | Low severity volume (mmbf) |
|---|---|---|---|---|
| Inside the interface | 6,424 | 51 | 3,100 | 11 |
| Outside the interface | 3,790 | 32 | 1,728 | 6 |
| **Total** | **10,214** | **83** | **4,828** | **17** |

### Vegetative Treatment Priority 4.

*Table 6-17. Potential timber volume in stands at moderate or high risk of Douglas-fir beetle infestation, East Fork*

| | High risk acres | High risk volume (mmbf) | Moderate risk acres | Moderate risk volume (mmbf) |
|---|---|---|---|---|
| Inside fire perimeter | 10,398 | 62 | 13,488 | 81 |
| Outside fire perimeter | 16,318 | 98 | 26,212 | 157 |
| **Total Acres or Volume** | **26,716** | **160** | **39,700** | **238** |

### Vegetative Treatment Priority 5.

*Table 6-18. Estimated mortality in VRUs 3 & 4, East Fork*

| VRU | High/moderate area | High/moderate volume (mbf) |
|---|---|---|
| 3 | 14,002 | 112 |
| 4 | 11,004 | 110 |
| **Total** | **25,006** | **222** |

## *4.6.5.2 Skalkaho - Rye Analysis Area*

### Vegetative Treatment Priority 1.

*Table 6-19. Accessible mortality in wildland-urban interface, Skalkaho-Rye*

| Fire Severity Class | Acres 70% Accessible | Mortality Volume (mmbf) |
|---|---|---|
| High/Moderate | 3325 | 27 |
| Low | 3661 | 13 |
| **Total** | **6986** | **40** |

### Vegetative Treatment Priority 3.

*Table 6-20. Potential Estimated mortality in VRU 2, Rye – Sleeping Child - Skalkaho*

| | High/mod. severity acres | High/mod. severity vol. (mmbf) | Low severity acres | Low severity volume (mmbf) |
|---|---|---|---|---|
| Inside the interface | 2,167 | 17 | 2,867 | 10 |
| Outside the interface | 6,156 | 49 | 5,343 | 19 |
| **Total** | **8,323** | **66** | **8,210** | **29** |

### Vegetative Treatment Priority 4.

*Table 6-21. Potential timber volume in stands at moderate or high risk of Douglas-fir beetle infestation, Rye – Sleeping Child - Skalkaho*

| | High risk acres | High risk volume (mmbf) | Moderate risk acres | Moderate risk volume (mmbf) |
|---|---|---|---|---|
| Inside fire perimeter | 13,264 | 66 | 16,204 | 81 |
| Outside fire perimeter | 13,217 | 66 | 23,845 | 119 |
| **Total** | **26,481** | **132** | **40,049** | **200** |

### Vegetative Treatment Priority 5.

*Table 6-22. Estimated mortality in VRUs 3 & 4*

| VRU | High/moderate area | High/moderate volume (mbf) |
|---|---|---|
| 3 | 10,169 | 81 |
| 4 | 18,801 | 188 |
| **Total** | **28,970** | **269** |

### 4.6.5.3 *West Fork Analysis Area*

**Vegetative Treatment Priority 1.**

*Table 6-23. Accessible mortality in wildland-urban interface, West Fork*

| Fire severity class | Acres | Salvage volume (mmbf) |
|---|---|---|
| High/Moderate | 1,940 | 15 |
| Low | 2,510 | 9 |
| **Total** | **4,450** | **24** |

### 4.6.5.4 *Blodgett Analysis Area*

**Vegetative Treatment Priority 1.**

*Table 6-24. Accessible mortality in wildland-urban interface, Blodgett*

| Fire severity class | Acres | Salvage volume (mmbf) |
|---|---|---|
| High/Moderate | 904 | 6 |
| Low | 90 | 270 |
| **Total** | **1074** | **6** |

## 4.6.6 Regulations and Direction

The Bitterroot National Forest Plan includes forest-wide management goals to: a) provide sawtimber and other wood products (including firewood for personal or commercial use) to sustain a viable local economy; b) provide habitat for supporting viable populations of native and desirable non-native wildlife; c) seek out opportunities for biologically appropriate and cost-efficient uneven-aged management; and d) provide an economically efficient sale program (USDA Forest Service, 1987). The Bitterroot National Forest Plan also includes forest-wide management objectives to: a) provide optimal habitat on elk winter range; b) maintain vegetative diversity on land where timber production is a goal of management, maintain sufficient old-growth habitat on suitable timberland to support viable populations of old-growth dependent species; c) maintain advance sale preparation at a level to provide flexibility in offering sales that are responsive to market conditions and economic efficiency; d) offer affordable sales; e) achieve a species mix of offered volume that is nearly proportional to standing

inventory; and f) convert high-risk or insect and disease infested stands to young, healthy stands (USDA Forest Service, 1987).

Forest-wide standards supplementing National and Regional policies, standards, and guidelines found in Forest Service Manuals, Handbooks, and the Northern Region Guide relevant to timber harvesting include: a) providing well-designed timber sales to be affordable to purchasers under average market condition at the time of sale; b) following Regional standards for tree utilization, management intensity, measurement, growth, suitability for timber production, tree openings, and silvicultural systems; c) increasing the use of available wood fiber consistent with management objectives and economic principles; and d) implementing the principles of integrated pest management through sound silvicultural prescriptions designed to consider past, current, and potential impacts from insects and disease.

Vegetation treatments using timber harvest may occur in Bitterroot National Forest Plan Management Areas 1, 2, and 3. These management areas are suitable for timber production and include goals of managing for healthy stands of timber and optimizing timber growing potential while optimizing forage and cover for big game on winter range (MAs 1 and 2) and meeting partial retention visual quality objective (MA 3). MA 5, which is designed to emphasize semiprimitive recreation activities and elk security, also allows timber harvest under certain conditions. MA 8a, which is also widely present in the analysis area, emphasizes elk security and old growth. Vegetation treatments may be applied to meet wildlife goals.

Additional direction for managing National Forest System lands comes from the Forest Service's Washington Office in the form of the Chief's direction on Ecosystem Management. The Northern Region, in response to Ecosystem Management and the 1990 Resource Planning Act, designed a package specifying how the Region will incorporate the new direction, and made it available in "Our Approach to Sustaining Ecological Systems" in 1992. Additional direction is continually evolving, most recently in the findings of the science documents and the Environmental Impact Statement of the Interior Columbia River Basin project.

Specific guidelines for timber harvesting are found in Forest Service Manual 2400 (Timber Management) and a number of Forest Service Handbooks resulting from FSM 2400 direction. Forest Service Handbook 2409.17 (Silvicultural Practices Handbook) R-1 Supplement 2409.17-94-1 gives specific direction on planning silvicultural practices related to timber harvest and other vegetation manipulation. Harvest cutting is done to implement the Forest Plan and has three major objectives: 1) develop forest conditions over time that benefit all allocated forest resources; 2) utilize the timber resource; and 3) sustain ecological function. Harvest cutting must meet ecological criteria, resource criteria, and management criteria.

The Code of Federal Regulations (CFR) is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the

Federal Government. 36 CFR 219.27 sets forth the minimum specific management requirements to be met in accomplishing goals and objectives for the National Forest System. Those management requirements are addressed as follows:

- Section (b) Vegetative Manipulation: (1) Multiple-use: All treatments are consistent with Bitterroot National Forest Plan goals and standards; (2) Assurance of lands treated can be adequately restocked based on prior reforestation efforts in the analysis area; (3) Not chosen for greatest dollar return; (4) Potential effects on residual trees and adjacent stands; (5) Avoid permanent impairment of site productivity; (6) Provide desired effects on all resources; (7) Practical transportation, harvest requirements, and preparation and administration.

- Section (c) Silvicultural Practices: (1) Suitability; (2) Allowable Sale Quantity; (3) Restocking; (4) Cultural treatments; (5) Harvest levels; (6) Even-aged regeneration harvests protecting other resources; (7) Forest pests.

- Section (d) Even-aged management: (1) Openings will be located to achieve the desired combination of multiple-use objectives and (2) Individual cut blocks will conform to maximum size limitations.

- Section (g) Diversity: Treatment activities designed to maintain the diversity expected in a natural forest modified slightly to meet the desired future condition of the area.

16 USC 1604 (g)(3)(F)(i) Clearcutting: Any recommended clearcutting must show that it is the optimum method to meet objectives and requirements of the Bitterroot National Forest Plan.

## 4.6.7 Literature Cited

Bryant, Ray, November 2000, USDA Forest Service, Defect calculations for fire damaged timber and Madison Gulch fire, Missoula, Montana.

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Rocky Mountain Log Homes Manager, October 2000, Discussion on house log utilization, Hamilton, Montana.

Wagner, Brian, November 2000, USDA Forest Service, Boyer fire timber quality, Missoula, Montana.

Stewart, Fred, November 2000, USDA Forest Service, timber volume and appraisal, Missoula, Montana.

United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, Forest Resources of the Bitterroot National Forest, May 2000.

United States Department of Agriculture, Forest Service, Forest Service Manual, Timber Management.

United States Department of Agriculture, Forest Service, Forest Service Handbook, FSH 2409.12, Timber Cruising Handbook.

United States Department of Agriculture, Forest Service, Forest Service Handbook, FSH 2409.18. Timber Sale Preparation Handbook.

Bitterroot Forest Plan, USDA Forest Service, 1987

## Appendix A. Morel Mushroom Action Plan for 2001

| ISSUE or TASK | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| NEPA | Unless there are significant impacts or extraordinary circumstances that cannot be mitigated, a decision memo may be sufficient under Chief's Category 31.1b(8), for permitting commercial use. This category does not require a project file or Decision Memo, but given the potential scope of the commercial harvest and associated issues, the documentation is recommended. Permitting buying stations and campsites may fall under 31.2(3), requiring a project file and Decision Memo. | Develop proposal and begin scoping to assess issues and significance.<br><br>Coordinate with Sue Heald (SO), Joan Dickerson (RO), and other forests expecting morels. See contacts list. |
| **PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION** | **DISCUSSION or PROS/CONS** | **ALTERNATIVES and RECOMMENDATIONS** |
| Will areas be "designated" for *commercial* harvest? If so, determine boundaries and how to mark them. | Pros:<br>1. Reduces conflicts between commercial and personal use harvesters.<br>2. Allows for more control of commercial harvesters.<br>3. Concentrates harvesters and their effects.<br>Cons:<br>1. Concentrates harvesters and their effects.<br>2. Could increase conflicts between commercial harvesters.<br>3. Limits harvesters' options for utilizing or maximizing yield. We may designate areas that end up with low yield and miss areas with high yield.<br>4. May require more administration. Commercial harvesters will try to go everywhere. | Propose designated areas that include mostly moderate and low severity burned areas.<br>Ask the public for their concerns during scoping.<br>Use a multi-forest permit (generated by RO) with designated area rates from R1 Amendment FSH 2409.22-97-2 Section 84.2, Minimum Rates and Units of Measure for Personal and Commercial Permits.<br>Rates for designated areas follow:<br>$20.00 7 days<br>$40.00 14 days<br>$60.00 21 days<br>$75.00 30 days<br>$100.00 Season |

| PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Will *commercial* harvest areas be competitively bid? If so, determine permit types (2400-3, 2400-1, Special use) | Pros:<br>1. Permit administration would be simplified by having one contractor in a given area.<br>Cons:<br>1. Cannot estimate quantity or quality or production prior to fruiting. Difficult to appraise value.<br>2. Layout and contract prep efforts increased during the short time between snowmelt and fruiting.<br>3. Harvesters generally are not organized nor employed by companies that would provide oversight. | The RO or other forests that have had morels don't recommend competitive bidding.<br>Consider delineating small, individually assigned harvest areas, if there is a need for absolute control over harvesters and their impacts. |
| Will areas be "designated" for *personal* use harvesting separate from commercial use areas? | Pros:<br>1. Reduces conflicts between commercial and personal use harvesters.<br>2. Allows for more control of harvesters.<br>3. Concentrates harvesters and their effects.<br>Cons:<br>1. Concentrates harvesters and their effects.<br>2. Will require more administration. Harvesters will try to go everywhere.<br>3. May limit harvesters' options for utilizing or maximizing yield. | Alternatives:<br>1. Designate personal use areas as anywhere except in designated commercial areas and "no harvest allowed" areas.<br>2. Designate personal use areas as anywhere except off-limit areas, including within commercial areas.<br>3. Designate personal use and commercial use areas as the same areas.<br>4. Designate specific personal use areas separate from commercial use areas.<br><br>Recommendation: #1. This separates commercial and personal users, facilitates permit administration, and allows flexibility for personal users to choose their favorite places. |

| PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Will *personal* use permits be required? If so, will they be charge or free use? | FSH 2409.18-91-3 (Timber Sale Prep Hdbk.), Section 87.72 allows for personal use gathering without a permit.<br>R1 Supplement requires a charge permit for personal use collecting within a designated commercial use area, otherwise personal use is free.<br>Personal use collecting outside designated areas does not require a permit, but the Forest could require it.<br>R1 Amendment FSH 2409.22-97-2 Section 84.2 provides Minimum Rates and Units of Measure for Personal and Commercial Permits.<br><br>Pros/cons:<br>Concerns from several forest employees, including LEO, could be best addressed by requiring ALL harvesters to obtain a permit. Personal use could be free.<br>LEO argument: If everyone has a permit, violators**<br><br>If personal use requires a permit, the potential workload for permit issuers could result in poor customer service. To provide adequate service, vendors would be needed, and/or FS offices would need to have extended hours. The expected response from personal users (mostly from W. MT) is that mushrooms should be no different from other forest resources (berries, cones, boughs, etc.) for which we don't require a personal use permit. | How and if personal use areas are designated will affect charges.<br>Designated areas will require a charge permit. Rates for designated areas follow:<br>$10.00 3 days<br>$20.00 7 days<br>$75.00 30 days<br>$100.00 Season<br><br>Undesignated areas (#1 or 2 above) could be free use permit or no permit.<br><br>Recommendation:<br>Do not require a personal use permit unless harvesters will be restricted only to designated areas. This is based on (all) examples from other regions and forests, concerns for the efficiency of permit issuing and consistency with other forest resource use policies, and the cost/benefit to the taxpayers. |

| PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| How will commercial and personal use permit requirements be distinguished (i.e. quantity, intended for resale, designated area, etc.)? | All other forests' examples use a limit of number of gallons for personal use. The number varies by forest or state. Washington and Oregon have state laws that dictate their amounts. | Alternatives:<br>1. Personal use quantity limit, e.g. 10 lbs, 1 gallon, 3 gallons, 5 gallons, etc.<br>2. Designated areas for commercial harvesting – anyone there must have commercial permit.<br>3. Honor system – if intended for resale, need commercial permit.<br><br>Recommendation:<br>Designate areas for commercial harvest. Establish a limit (1-3 gallons/person) for personal use outside the commercial areas. |
| Will there be areas where no harvesting is allowed (e.g. wilderness, RNAs, designated roadless areas, developed recreation sites, administrative sites, elk summer range, calving areas in spring, tribal use areas)? | 1. FP direction for recreation and access mgt. RNAs. MA 9 is only MA that explicitly excludes "manipulation and discourages recreation access.<br>2. Use scoping to clarify issues.<br>3. Use effects analysis, especially input from:<br>a. Botany – avoid rare plant populations.<br>b. Wilderness/recreation<br>c. Wildlife biologist – disturbance<br>d. Timber/silviculture - safety around logging operations or avoid | Recommendation:<br>Allow no commercial harvest in RNAs, wilderness, developed recreation sites, and administrative sites (others?).<br>Propose no personal use harvest in RNAs, but allow in all other areas.<br>Use signs/posters, information handouts, maps, and other media to clearly identify "no harvest allowed" areas. |
| What types of access will be allowed? Where? (motorized – ATV, stock, carts, walking only). | | Use existing access guidelines or restrictions. |

| PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Will special provisions or areas be set out for harvesters with disabilities? | Use scoping to determine need. | Designate a well roaded, low slope area in moderate severity burn as a handicapped area. Require users to have a state handicapped endorsement on their vehicle or issue day use gate keys. |
| Will *buyers* be authorized to operate on NF lands? If so, determine locations, numbers, costs, and prepare Special Use Permits. | Buyers want locations that are between the harvest areas and the camps or between harvest areas and town or in camps. Buying stations must be large enough to accommodate a travel trailer, portable toilets, and up to 5 harvesters' vehicles. They must have adequate sight distance for harvesters to see the station and for safe turning in and out of the station.<br>Buyers may be most effective in towns in the Bitterroot.<br>If buyers contact districts, it may be an indication they are looking for FS sites, based on scouting trips this fall. | Coordinate with private landowners near commercial harvest areas to encourage them to host buyers.<br>After designating areas, determine if appropriate buying stations are available on private lands. If not, designate buying stations and prepare Special Use Permits to issue, if the need arises.<br>Buying permits are $500 each. |

| PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Preparing T.I.M. product plan and permits:<br>Season length<br>Permit types/process (hard copy vs. TIM, batch vs. individual)<br>Venders | These items will be discussed at a coordination meeting at the RO on Dec. 7, 2000.<br>RO may take the lead in preparing a multi-forest permit, similar to firewood permits, if Forests will have similar terms and conditions.<br>Season length: There are at least 3 species of morels. They fruit under different conditions. Fruiting could occur up to 4 months, but usually about 1 month.<br>Venders can provide extended hours and convenient locations for obtaining permits. But they may not have time or informed employees to provide adequate information to permittees. | Season length: Permit expiration dates (T.I.M. product plan). Allow for a longer season that anticipated. Reduces rework, if morels fruit into fall. Recommend May – October.<br>Permit terms and conditions may need a statement added to say permittee will be suspended from receiving FS permits for 3 years for violations. Stacie DeWolfe<br><br>Venders: if the forest already uses venders for firewood permits, and/or personal use permits will be required, consider asking vendors to issue permits. Commercial permits are best issued from FS offices or venders prepared for non-English speakers and with time to issue up to 20 permits in a row. |

| PERMIT TYPES, HARVEST AREAS, and RESOURCE PROTECTION | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Environmental impacts to anticipate. | Research literature identifies research needs about the impacts of harvesting and over-harvesting on the viability of the various species. Based on what is known about the reproductive biology of morels, researchers consistently state there is no reason to believe that removing the fruiting body has any effect on the mushroom plant (mycelium).<br><br>If there are a lot of harvesters using the same area, trails may become established. This could have soil and water impacts if they are on steep slopes, erosive soils, or near poorly vegetated riparian areas.<br><br>Litter and user conflicts are usually the biggest impacts. | Harvesters should be required to cut the caps off and not damage the "roots" (mycelium). Do not allow raking, digging, dragging, or other ground disturbing harvest methods.<br><br>Monitor trail formation and mitigate by constructing drainage features, closing area, or other appropriate actions.<br><br>Encourage "Leave No Trace" techniques.<br>For commercial harvesters, litter control is a requirement. But – is hard to enforce unless the offender is caught in the act.<br>Be prepared to provide post-harvest cleanup. |

| PUBLIC INFORMATION, SOCIAL, and CULTURAL ISSUES | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Develop a public information plan. | How will people provide input to management decisions about the harvest plan?<br>How will information about the harvest plan and expectations be distributed to FS employees and publics?<br>How will the Forest coordinate with local businesses and landowners to prepare for the influx of harvesters? | Do a rough plan prior to scoping. |
| Develop a mushroom information guide and map(s) for harvesters. (Translated versions?) | RO may take the lead in preparing information guide. Forests need to provide maps – may be attachment to permit.<br>Many harvesters may not speak or read English. R6 has translated their info and permits into several languages. Estimated cost is $75-$100 per language per document. | Use PAO and Environmental Education coordinator. See examples from R6, Kootenai, and Flathead. |
| Safety | Harvest area designation and information guide should include consideration of the vicinity of logging operations; snags; down logs on steep slopes; local traffic on private, public, and forest roads; etc. | Avoid designating commercial harvest areas where there will be concurrent logging.<br>During logging operations, make those areas off-limits to all mushroom harvest.<br>Include safety alerts in the information handouts, maps, and posters. |
| Cultural/social differences | Permit administrators, LEOs, other forest personnel, business community may want some orientation on cultural values of potential harvesters to avoid conflicts and promote acceptance. | Contact Jerry Smith, R6 for ideas.<br>Kuaychang "Kao" Chin (Oregon State Police (former?)) may be available for speaking engagements or workshops. He is from Laos. |

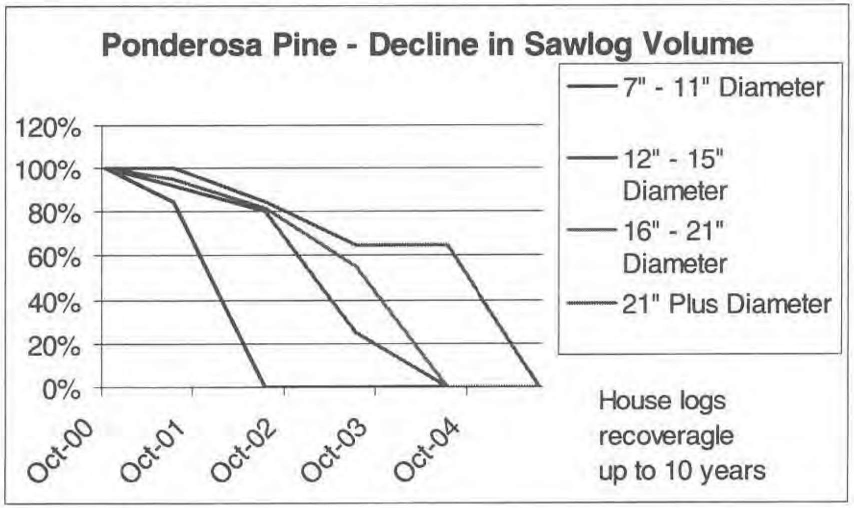
| PUBLIC INFORMATION, SOCIAL, and CULTURAL ISSUES | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Coordinate with RO and other neighbor forests (and DNRC? NRCS?) on designated areas, permit types, and costs. | See contact list.<br>Paul Moore (DNRC) wants to use the same "rules", fees, and permits as the FS, if possible. | Share this and future information and include DNRC in NEPA and permit planning process. |
| Consult with Indian tribes that may use the area for gathering plants or other purposes under "treaty rights" to insure their needs can be met and not impacted. | Discuss with Native American coordinator at RO for advice on how to proceed and with which tribes. | If personal use permits are required, decide if tribal members will need permits (charge or free use?). Determine if personal use quantity limits are acceptable for tribal member needs. |

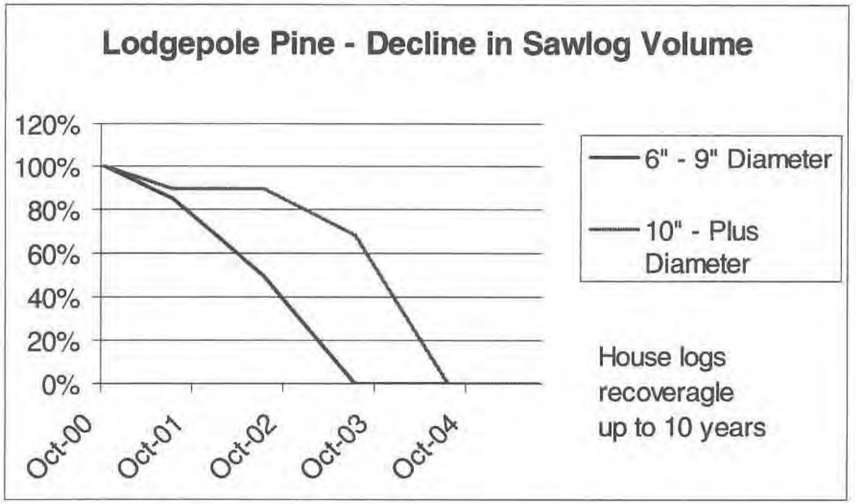
| CAMPING | DISCUSSION or PROS CONS | ALTERNATIVES AND RECOMMENDATIONS |
|---|---|---|
| Decide if harvesters will be allowed to *camp* on NF lands. Decide if FS will charge for camping or if camping services will be contracted (concessionaires) or if campers must provide their own (water, toilets, garbage removal, etc.). | If camping will be allowed on NF determine locations, plan for sanitation and law enforcement.<br>Camping areas for commercial harvesters should be near the harvest areas and large enough to accommodate up to 30 people. Experience from R6 and other R1 forests indicate that the best camp design is linear, with campsites marked, similar to how our developed campgrounds are designed. This facilitates sanitation, accountability, and law enforcement. When camps are not planned and campers are scattered randomly throughout an area, LEOs are reluctant to patrol individual sites.<br>Some people recommend have several camps so family groups or ethnic groups can choose to segregate. A linear camp reduces those conflicts by allowing each person (family) their own space and facilitating a LEO "presence".<br>Sanitation and conflicts at camps are the biggest problems encountered with most morel harvest areas.<br><br>If FS will provide services and charge, determine amount. Create reimbursable account to deposit camper fees and pay for services. Make sure the camping permit references the Granger-Thye Act of April 24, 1950 (P.L. 81-478), to allow forest to keep and use the fees, instead of returning them to the NF fund.<br><br>Concessionaires are used in R6 for more permanent mushroom camps (matsutake & chanterelle harvests). This carries the same risk as leasing or bidding harvest areas – if the production or prices are too low to attract commercial harvesters, the concessionaire incurs cost and time commitments without income. | Recommendations:<br>Inform private landowners, especially campgrounds, of the opportunity to host (and charge) harvesters. If response is positive near commercial harvest areas, consider allowing no camping on NF.<br><br>If private land camping opportunities are insufficient in the vicinity of the harvest areas, establish camps as described (linear design). Charge for and provide services, at a minimum, portable toilets.<br><br>Charge each camper an adequate fee to cover costs. (The Flathead example of charging a reduced fee for additional campers didn't work well and didn't cover costs – family groups got very large when they saw the reduced fee.) |

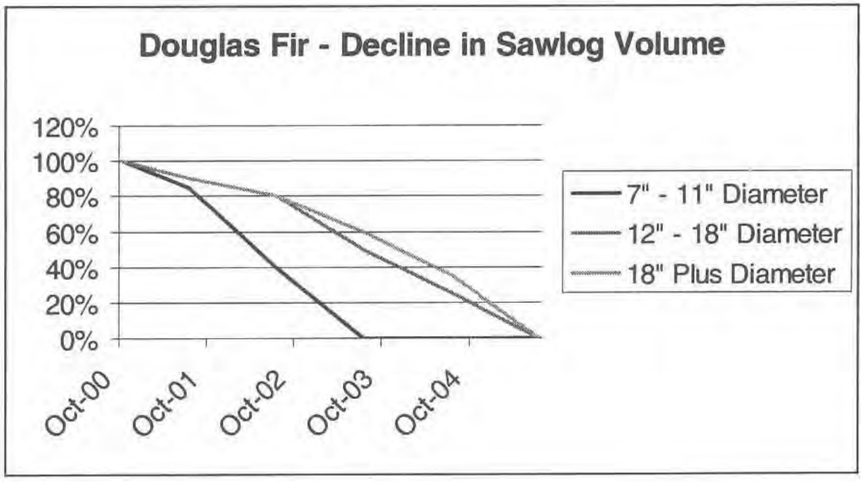
| ADMINISTRATION and LAW ENFORCEMENT | DISCUSSION or PROS/CONS | ALTERNATIVES and RECOMMENDATIONS |
|---|---|---|
| Develop law enforcement plan in conjunction with other LE agencies and based on harvest plan. | It is critical to have LE involved from the beginning with the permit and camping requirements. They need a coordinated multi-agency plan to insure authorities and priorities are established. | See example from Flathead. |
| How and who will administer permits? | LEOs and/or permit administrators can be used for compliance. Often, LEOs deal with permit violations and other apparent breaches of law or regulation. Contract/permit administrators perform routine inspections for harvest and camping permit compliance and report uncorrected violations or other suspect activity to LE. | Determine roles and responsibilities for permit administration well before the harvest season and ensure adequate staffing.<br>Utilize Forest Protection Officers and/or people with contract administration training and experience. Friendly, firm, solution seekers. |
| **OTHER ISSUES** | **DISCUSSION or PROS CONS** | **ALTERNATIVES and RECOMMENDATIONS** |
| Anticipate other non-timber forest products that may be available in and near the mushroom harvest areas and campsites. Decide if permits will be issued. If so, consider including in NEPA for mushrooms. | | |

Prepared by Betty Kuropat 11/9/2000

Appendix B. Decline in saw log volume over 5 years (percent of tree defect occurring from fire and mechanically damaged trees)



# 4.7 Grasslands and Weeds

## 4.7.1 Background

### *4.7.1.1 Introduction to Grasslands and Weeds*

Grasslands are relatively rare on the Bitterroot National Forest. These areas are very important as winter range and for plant community diversity. The largest threat to native grasslands is noxious weed invasion. These two subjects are interrelated, and one can't be discussed without the other.

Thirteen invasive species are known to occur on the forest. The most important species are spotted knapweed, which infests the greatest area, and leafy spurge, which has the potential to infest large areas. Both are on the Montana noxious weed list. Rush skeletonweed is an important noxious weed on the Idaho side of the forest, and occurs on the steep slopes of the main Salmon River near Fawn Ridge.

Noxious weeds can be considered biological pollutants. In *Weeds of the West* by Whitson et al. (1992), a weed is defined as "a plant that interferes with management objectives for a given area of land at a given point in time." The Montana Noxious Weed Control Act defines a noxious weed as any exotic plant species established or potentially established in the State which may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses, and is further designated as either a state-wide or county-wide noxious weed (7-22-2101 CMA).

Weeds are different from other large scale wildland disturbances in two ways (Kulla 1998): 1) wildland ecosystems do not have the ability to recover from an exotic plant invasion without management intervention, and 2) weeds are a dynamic rather than a static situation; a decision to take no action (or the lack of a decision) is a *de facto* decision to allow weeds to spread.

### *4.7.1.2 Regional Context*

According to the scientific assessment of the Interior Columbia Basin, invading weeds can alter ecosystem processes such as productivity, decomposition, hydrology and, nutrient cycling. They can alter natural disturbance patterns such as frequency and intensity of wildfires (Quigley et al., 1997). Changing these processes can lead to displacement of native plant species and associated impacts to both game and non-game species.

Invasive vegetation can be as damaging to natural resources as pollution of air or water. Weed invasion, left untended and allowed to spread to vast acreages, is in many ways the most irreversible wildland impact occurring today. The degradation of public land resource values from noxious weed infestations also has economic impacts. A study on the impact of spotted knapweed on Montana's economy (Hirsch and Leitch, 1996) found that spotted knapweed infestations in wild lands have affected wildlife-associated recreation expenditures and soil and water conservation benefits. Total direct impacts of

wildland knapweed infestations on Montana's economy are estimated at $3.1 million annually, or $3.95 per infested acre per year. As the complexity of the weed issue has expanded and intensified, many individuals and government agencies have come to realize there is a need to respond to the specific impacts of weeds on big game winter ranges.

### 4.7.2 Issues

Key questions include:

- Will noxious weeds increase as a result of the fires?
- What impact will the fires have on grassland ecosystems?
- What should be done to restore the native grasslands?
- What effect will noxious weeds have on soil erosion?
- Should these fires be considered natural events?
- What effects did grazing have on burn patterns?
- What effect will the fires have on the Forest's grazing program?

### 4.7.3 Historic and Pre-fire Conditions

The biggest change between historic and current conditions on the Bitterroot National Forest is the amount and distribution of invasive plants that have been introduced into native ecosystems. There are several causes for the noxious weed invasion, though none are natural processes. Invasion first occurred on private land where domestic livestock grazing occurred.

Noxious and undesirable weeds have established themselves throughout the Bitterroot National Forest. Many weed species reproduce by sprouting from roots as well as by abundant seed production. These factors, along with a lack of natural predators or vegetative competition, allow weeds to spread rapidly into areas where their presence is not desired.

The Bitterroot is considered to be a stronghold for spotted knapweed, with approximately 275,000 acres infested. Most south-facing slopes with less than 40 percent canopy and below 6,500 feet in elevation are infested. The few grassland areas that are not infested are vitally important for forage and plant community diversity.

Spotted knapweed has been in the Bitterroot Valley for over 100 years. It first infested disturbed areas, but has since invaded intact ecosystems that were never grazed by domestic livestock or disrupted in any way. Knapweed was first identified along the main Salmon River ( **Figure 7-1, Appendix A**). in the late 1970s and most likely became established there as a result of floods during that decade (USDA Forest Service, 1999) .

Leafy spurge **(Figure 7-2, Appendix A)** infests less than 100 acres, but that is in light of a vigorous herbicide application program

Noxious weed infestations are relatively small and manageable in the Frank Church-River of No Return wilderness. The Selway-Bitterroot wilderness is, however, infested with spotted knapweed on a landscape scale similar to the Bitterroot River drainage. Consult Section 5.13 for more information on noxious weeds in wilderness.

Approximately 7,000 acres of grasslands in the southern portion of the Forest were at differing levels of infestation of spotted knapweed before the fires **(Figure 7-3, Appendix A)**. These levels range from total monoculture to less than 10 percent infested. Grasslands that are considered 100 percent clean are rare on the Bitterroot. Warm Springs Ridge from Porcupine Saddle to Maynard Creek is the only documented "clean" grassland of notable size.

The Reimel/Barley Ridge area has isolated spots that are fairly clean. This area is unique in that spotted knapweed was not reported until a 1985 range study (2210 files), while most other areas were infested many decades ago.

Privately owned lands near and adjacent to the National Forest are used for hay production and livestock grazing. Many of these boundary lands are sources of noxious weed spread, especially when the land belongs to absentee owners.

### 4.7.4 Effects and Implications of the Fires of 2000

**Forest-wide effects.** Noxious weeds will probably expand their range under the current post-fire conditions. The fires established a seedbed and in some cases removed all of the vegetative competition. Areas that were relatively "clean" of noxious weeds are now susceptible to infestation. Both spotted knapweed and leafy spurge have the ability to spread into burned areas, and infested acres are likely to increase if not treated. Animals, vehicles, and foot traffic are all potential vectors for weed spread into areas that were weed-free before the fires.

Since spotted knapweed is so prevalent on the Bitterroot, it had a considerable influence on which areas burned and which didn't. Spotted knapweed stays green longer into the summer than most native grasses, and usually doesn't burn readily at that time of year. Some grassland areas infested with spotted knapweed *did* burn, which indicates the

intensity of the fire when it went through those areas (most notably Sula Peak). However, this anomaly may have been more due to grazing patterns than knapweed.

In a native fescue community in Glacier National Park, spotted knapweed-infested sites were shown to significantly lower species richness, native forb and graminoid canopy cover, and cryptogram crust ground cover than un-infested sites (Tyser, 1992). Spotted knapweed readily establishes on disturbed sites, but does not offer as much erosion control as grasses. Under simulated rainfall conditions, a spotted knapweed infested area yielded 56 percent more runoff and 192 percent more sediment than an area dominated by bluebunch wheatgrass (Lacey, 1992).

Spotted knapweed is intolerant of shade and shows moderate increases after fire. Established plants may re-grow and buried seed may germinate after fire. This increase occurs on both dry and moist sites.

Leafy spurge also increases with fire, for several reasons. Fire suppression tactics may have spread weed seeds, and fire lines that cut through leafy spurge patches may have stimulated sprouting.

**Bitterroot River mainstem.** Most of the National Forest grasslands in this area are adjacent to private land. There has been a concerted effort by the County to pool money and treat weeds on both sides of the fence in these areas

**West Fork of the Bitterroot River drainage.** This drainage has fewer grasslands, but it does contain native grasslands on Rombo Ridge **(Figure 7-4, Appendix A)** and Shook Mountain that are relatively free of spotted knapweed. Both of these areas have been treated with herbicide in the past and shown positive results. Also important for noxious weed management are Chicken and Deer Creeks, which are possible sources of spread into the Selway-Bitterroot wilderness. Currently no livestock grazing occurs in these areas.

**East Fork of the Bitterroot River drainage.** Approximately half of this large drainage burned in the fires of 2000. This area has approximately 5,000 acres of grasslands that are infested to varying degrees with spotted knapweed. The worst areas of infestation are from Sula Peak to Elk Point; these grasslands are almost a monoculture of spotted knapweed, and also are being encroached by conifers on some aspects and slopes. These grasslands are important winter and summer range for domestic livestock and wild ungulates. The fires generally burned less intensely where spotted knapweed was dominant **(Figure 7-5, Appendix A)**.

Other grassland types were left untouched by fire because the surrounding knapweed areas acted as a firebreak (for example, Barley Ridge). In fact, some caged test plots burned exclusively since they contained ungrazed grass **(Figure 7-6, Appendix A)**.

Given these observations, it seems that the amount of knapweed had some influence on burn patterns. It is possible that many more grasslands would have burned without

knapweed and livestock grazing. Neither of these conditions should be considered natural or within historic ranges. Though some ungulate grazing did occur historically, there was probably less than there is now. In addition, there were probably more grasslands available to wild ungulates before the exclusion of fire.

Warm Springs Ridge is at the other end of the spectrum. It is free of spotted knapweed, although adjacent areas do contain small infestations. Forested stringers burned in pockets adjacent to this ridge and at the bottom of the ridges near Warm Springs Creek. This area was also burned from the east near Porcupine Saddle, though this was a small percentage of the entire grassland.

These areas receive moderate OHV use by both permittees (grazing and outfitters) and the public.

**Rye Creek/Sleeping Child/Skalkaho drainages.** Although spotted knapweed has infested all of these areas, leafy spurge is a greater concern. No leafy spurge has been found in Rye Creek thus far, but the Sleeping Child and Skalkaho drainages contain approximately 100 acres of spurge **(Figure 7-7, Appendix A)**. These areas are scheduled for treatment under the Burned Area Emergency Rehabilitation program.

**Canyon /Blodgett/Mill /Sheafman drainages.** These west side canyons are potential routes by which weeds may spread into the Selway-Bitterroot wilderness. All but Mill Creek have been treated for spotted knapweed in the past. These areas were burned to differing degrees and are now at increased susceptibility to noxious weed infestation.

## 4.7.5 Objectives and Recommendations

### *4.7.5.1 Rehabilitation Focus*

The highest rehabilitation priority should be protecting the grasslands that are relatively clean but are susceptible to infestations after the burn. These areas provide very important big game winter range.

The second highest priority should be the adjacent grassland areas that were infested previously, but that have some native vegetation component remaining. Efforts should be made to combine funding sources to treat areas on a landscape scale, and not just in the burn.

In addition to these areas, reforestation efforts should be geared toward providing shade as soon as possible to keep spotted knapweed out.

Since leafy spurge is an aggressive, persistent, rhizomatous perennial, this plant should be eradicated wherever possible. Leafy spurge is highly susceptible to herbicide application after fire.

Aerial applications of herbicide should be considered a viable tool. There are several reasons aerial application is preferable in steep, inaccessible terrain, where many of these grasslands occur. Aerial application is more cost-effective, uniform, effective, and requires fewer personnel.

Biological release of agents that affect spotted knapweed or leafy spurge should continue, as well as the weed-free hay requirement and the Northern Region's noxious weed "Best Management Practices".

Seeding of native grasses should be used in conjunction with herbicide spraying when areas are heavily infested.

Herbicide application should occur along roads affected by the burns. These roads are major sources of spread for noxious weeds.

The Selway-Bitterroot and the Anaconda-Pintler wilderness areas should be inventoried for new weed infestations and for sources of spread (outfitter camps, trails, dispersed campsites). Herbicide application programs in the Frank Church-River of No Return and the Montana side of the Selway-Bitterroot should continue **(Figure 7-8, Appendix A)**.

In summary, noxious weed recommendations are:

- Keep clean areas clean.
- Treat areas that have a remaining native component.
- Treat the sources of spread.
- Contain infestations that are too big to effectively eradicate.
- Eradicate new species invasions.
- Use an integrated approach incorporating chemical, biological, and mechanical means where appropriate.
- Continue to educate Forest users on how they can help stop the spread of noxious weeds.
- Seed native grasses to ensure success of establishment in heavily infested areas.

### *4.7.5.2 Range*

Each grazing allotment that has been burned will be evaluated and determined if adjustments in the Annual Operating Plan (AOP) are necessary. If areas are identified that should be excluded from cattle grazing, the Forest Service will work with the permittee on a grazing plan that will protect sensitive areas. If this cannot be done without cattle exclusion, then we will try to locate an alternative grazing area that would be suitable.

Not all range improvements will be replaced or repaired by the time cattle are turned out in spring of 2001 **(Figure 7-9, Appendix A).** ***For the next two or three years,*** the grazing program will be playing catch-up. Consorted effort will be made to make this program successful as possible, and repair the fences and water developments damaged by fire.

North Sleeping Child, Medicine Tree, Sula Peak, and East Fork Allotments were each burned over a substantial part of their area. These allotments should be assessed to determine if portions (or all areas) within the boundaries should be rested from cattle grazing.

### *4.7.5.3 Opportunities to Work with Citizens, Agencies, and Research*

- ✓ Conduct controlled studies to gain more knowledge of weed response following fire
- ✓ Determine what kind of weed response is likely to occur with different burn severities, post-fire tree canopy levels, and proximity to existing weed populations

## 4.7.6 Regulations and Direction

### *4.7.6.1 Forest Plan Direction*

The Bitterroot National Forest Land and Resource Management Plan contains goals and objectives regarding noxious weds. A forest-wide management goal is to "control noxious weeds to protect resource values and minimize adverse affects on adjacent private lands" (page II-3).

The Forest Plan lists two objectives with regard to noxious weed management:

1. "Complete an evaluation of the risk of spread of noxious weeds in vegetative communities and implement control strategies."

> This evaluation has been completed and is documented in a 1987 report entitled "An Evaluation of Noxious Weeds on the Lolo, Bitterroot and Flathead Forests" (Losensky, 1987).
>
> The recommended control strategy for spotted knapweed is containment. New satellite infestations of this weed (particularly along road corridors) indicate that the population sizes have not been maintained at their 1987 level.

2. "Emphasize the use of biological control to gain the upper hand in the control of spotted knapweed and leafy spurge." The Forest remains active in supporting biological control research and insect releases on the Forest.

The Forest's Noxious Weed Implementation Guide (1993) specifies individual exotic species and management approaches for each. For example, "eradication" is prescribed for leafy spurge, due to its limited distribution, aggressive nature, and potential ecological effect.

Several site-specific weed management analyses and decisions have been completed and implemented on the Bitterroot National Forest over the last 15 years. These plans have been very specific to one kind of treatment on a designated site.

State laws and county ordinances require that all landowners be responsible for control of noxious weeds on their lands.

The Bitterroot National Forest uses Integrated Pest Management (IPM) principles in managing various pests, including noxious weeds. These principles are defined in Forest Service Handbook 3409 (Forest Pest Management). Strobel (1991) and (Ralphs et al., 1991) state that a single management method will not be successful, but that implementing a fully integrated approach in weed management significantly improves the chances of a successful program.

A variety of activities can be carried out under an IPM program. IPM provides a full range of management alternatives. Prevention and public education are also part of IPM activities. The overall forest strategy is to keep weeds out of relatively weed-free areas and limit weeds to currently infested areas. This includes areas east of the Forest boundary that are relatively free of spotted knapweed. Prioritization has been given to treatment of areas that may contribute to the spread of weeds – mainly areas that could spread knapweed into Beaverhead and Granite counties and the Anaconda-Pintler wilderness.

## 4.7.7 Literature Cited

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## Appendix A. Photos

**Figure 7-1.** Salmon River Canyon.


**Figure 7-2.** Leafy spurge in the Skalkaho Creek drainage.

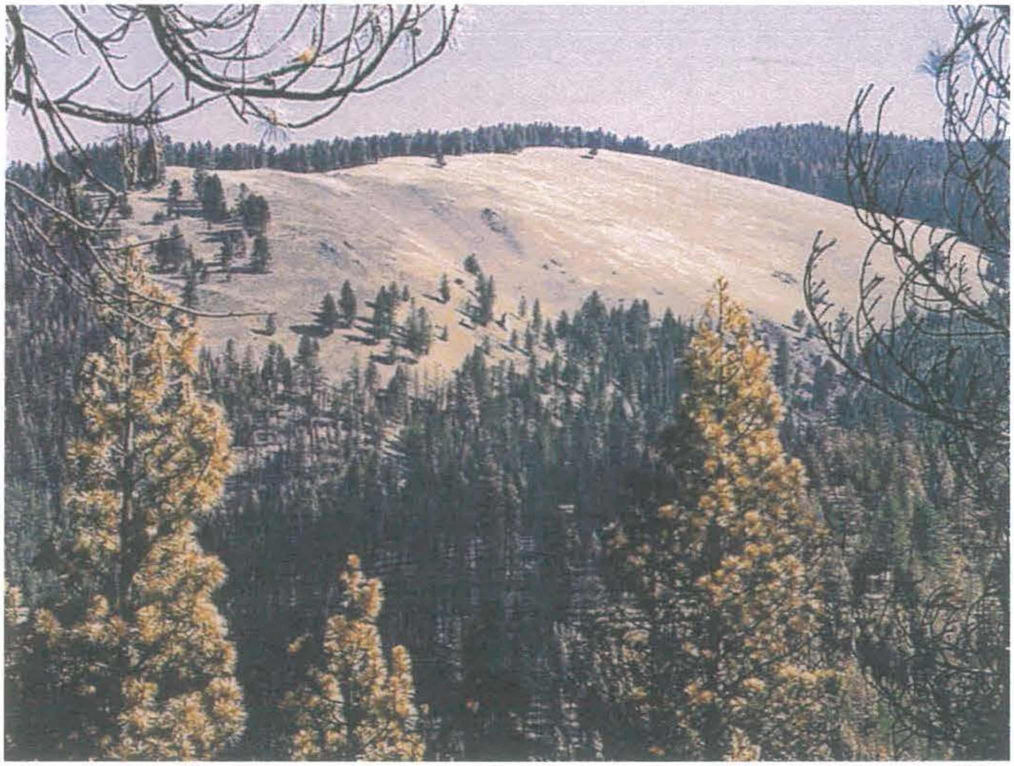


**Figure 7-3.** Grasslands on the southern portion of the Bitterroot National Forest.


**Figure 7-4.** Native grasslands on Rombo Ridge.

**Figure 7-5.** Burn pattern in a spotted knapweed / grassland mix.

**Figure 7-6.** Un-grazed test plot that burned exclusively.


**Figure 7-7.** Leafy spurge re-sprouting after fire.

**Figure 7-8.** Herbicide application in the wilderness with the use of horses and mules.

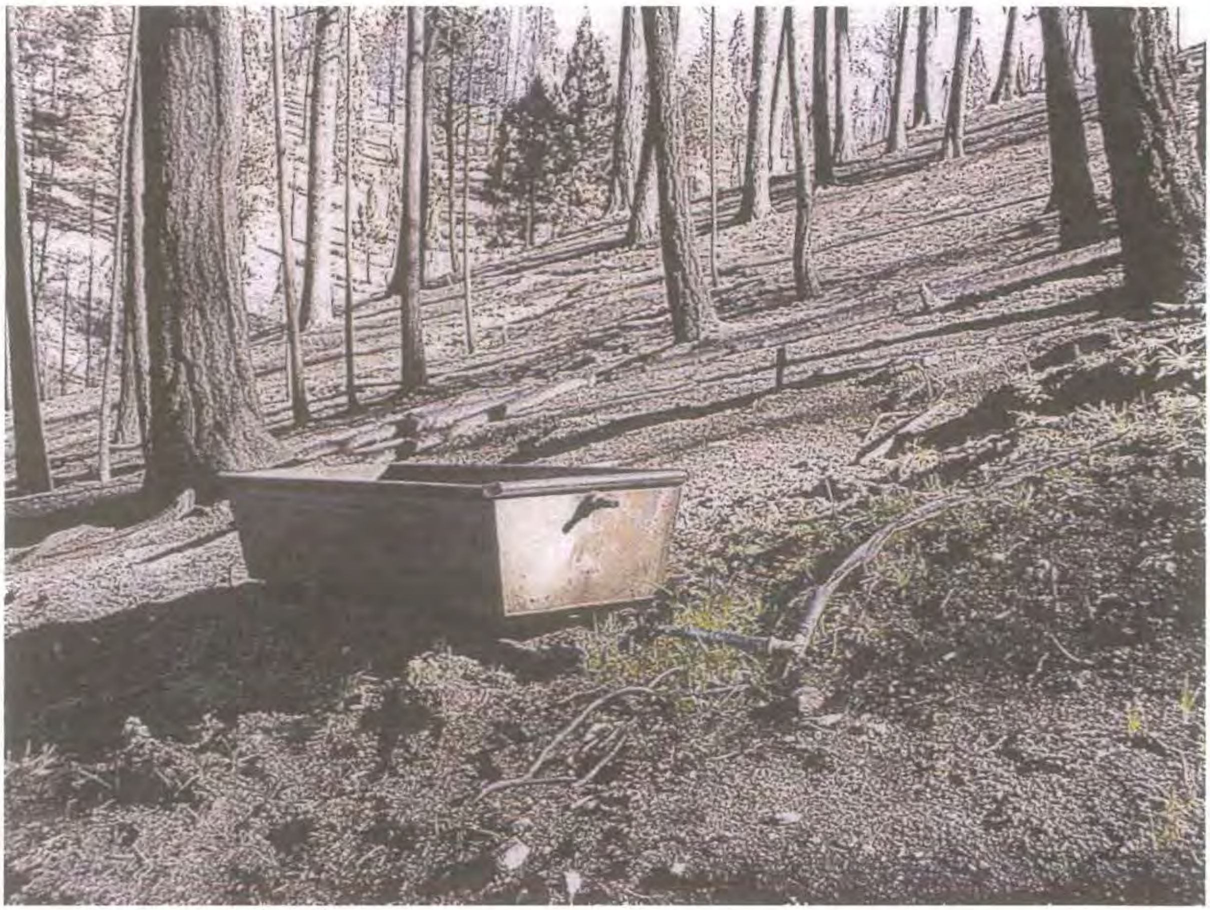


**Figure 7-9.** A fire-destroyed water development in the Medicine Tree allotment.

# 4.8 Fire and Fuels

## 4.8.1 Background

### *4.8.1.1 Introduction to Fire in the Bitterroots*

Wildfires are the major natural process vegetation composition on the Bitterroot National Forest and adjoining forested lands. Descriptions of pre-settlement vegetative conditions are available in Leiberg's "The Bitterroot Forest Preserve,"(Leiberg, 1898). This reference describes a landscape heavily impacted by wildfire. Maps from this period represent of the fire dynamics on the forest before European settlement.

Some of the earliest and best documentation of fire and its effects came during and after the severe fire season of 1910. Although the Bitterroot National Forest was spared the brunt of this severe season, the 1910 fires affected the Northwest socially and politically. Eighty-five firefighters were killed and over three million acres were consumed by fire in a two-day wind event. The public and forest managers alike came to view wildfire strictly as a destructive force that must be eliminated from the forest at all costs.

This mindset laid the groundwork for forest management policies with zero tolerance for wildfire. The Bitterroot National Forest, in conjunction with the rest of the Forest Service, states, and private landowners, began an energetic effort to suppress wildfires for the preservation of natural resources and protection of property. Detection efforts included the development of stationary lookouts with communications and aerial reconnaissance. The Forest Service initiated the "10 A.M." policy, which states that the objective in wildland firefighting is to contain all fires by 10 AM on the day after detection. In the decades following, advances in suppression capabilities increased rapidly. Aircraft increased initial attack effectiveness in remote areas. Roads were constructed on much of the land, enabling fire suppression resources to access many areas.

These efforts were rewarded with a downward trend in the number of acres burning per decade from 1920s through the 1970s. In the 1950s, Smokey Bear was established as a fire prevention icon, and helped reinforce the public's negative impressions of wildland fire.

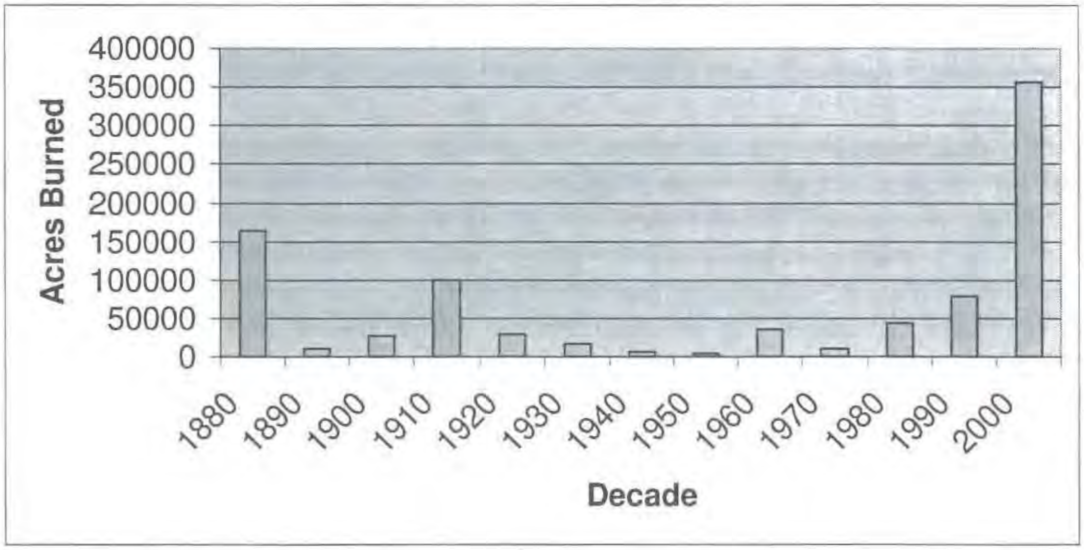
In 1964 the Wilderness Act established the first wilderness lands in the United States. The purpose of this Act was to provide areas of land managed for ecological integrity and minimal impact from the activities of humans. This increased public awareness of fire's natural role and the environmental consequences that can ensue when fire is excluded. In 1974, the first prescribed natural fire was allowed to burn in the Selway-Bitterroot Wilderness. Since that time, the number of fires allowed to burn in the Wilderness has increased under the scrutiny of fire managers.

In the 1980s, an increase in the number of acres burned in the U.S. caused concern in the fire community. The successful suppression activities of previous decades had created

fuel accumulations that contributed to fire intensities that surpassed firefighting capabilities. The upward trend of acres burned continued in the 1990s.

Figure 8-1 illustrates acres burned on the Bitterroot by decade.

***Figure 8-1. Acres burned by decade on the Bitterroot National Forest***




In 1995, the Federal Wildland Fire Policy and Program Review was initiated. Some of the principles of this review include: 1) firefighter and public safety are the first priority; 2) wildland fire is an essential ecological process and natural change agent; 3) fire management plans must be based on the best available science. This policy contains direction to allow wildfire and use prescribed fire to restore fires natural role in appropriate areas.

The fire season of 2000 was a dramatic example of wildland fire potential. More than 356,000 acres of public and private land were burned on and near the Bitterroot National Forest. This points to another critical issue that is confronting land managers throughout the West, the wildland-urban interface (see Section 5.9).

### *4.8.1.2 Regional Context*

The findings and recommendations from the Interior Columbia Basin Ecosystem Management Plan (ICBEMP) are relevant to the Bitterroot landscape. Many of the predictions became reality in the summer of 2000. The ICBEMP characterized current vegetation conditions and trends as compared to historical conditions (early 1800s) and includes the following findings.

- There has been a 27 percent decline in multi-layer and 60 percent decline in single-layer old-forest structures from historical levels. The decline has occurred mostly in ponderosa pine and dry Douglas-fir forest types.

- The threat of severe, lethal fires has increased by nearly 20 percent, mainly in the dry and moist forest types. Fire frequency has generally decreased. Very frequent and frequent fire regime intervals have declined by approximately 32 percent, which is largely due to effective fire prevention and suppression strategies, selection and regeneration cutting, livestock grazing, and introduction of exotic plants. Under historic conditions, lethal fires occurred on approximately 20 percent of the area, and non-lethal fires on 40 percent. The percentage of area affected by lethal fires has increased to 50 percent and that affected by non-lethal fires has decreased to 15 percent.

- Area and connectivity of early-seral forests has declined, especially where mixed severity or lethal fires were the norm. These structures have been replaced to a substantial degree with mid-seral forest.

- Intermediate-aged forest has increased dramatically in area and connectivity, as has the volume of timber in small diameter classes.

- As a result of fire exclusion, selective harvesting, and grazing, forests have expanded in areas of historical woodland and shrubland, and forest canopies became more complex and layered.

- Fire severity has generally shifted from non-lethal and mixed severity to lethal regimes as a result of fire suppression and longer intervals between fires.

- Forests have become denser with greater occurrence of shade-tolerant species. They have become more susceptible to severe fire, insect, and pathogen disturbances.

- Forest composition and structures have largely become more homogeneous.

ICBEMP goes on to say that the continuation of traditional vegetation management by individual stand is unlikely to reverse the trends described above. This is because in the last 100 years wildfire intensity has doubled; insect, disease, and fire susceptibility have increased by 60 percent; whitebark pine has decreased in moist/cold forested vegetation types due to blister rust; native grasslands have decreased by 70 percent; native shrublands have decreased by 30 percent; large residual trees and snags have decreased by 20 percent; and old forest structures have decreased 27 to 60 percent depending on vegetation type. The greatest changes in landscape patterns and processes, according to the ICBEMP, have been in roaded areas historically managed with intensive treatments (Quigley et al., 1997).

Quigley et al., 1997, suggest that it is not possible to "fireproof" ecosystems, but that the potential of severe fire can be reduced by proactive land management with particular focus on the wildland-urban interface. This analysis also found that forested ecosystems have become more susceptible to severe outbreaks of insects and diseases. To reduce these risks, it is necessary to maintain forest cover and structures within a range consistent with inherent disturbance processes.

## 4.8.2 Issues

To what extent were the fires of 2000 "natural events" (historic fire regime as compared to fire behavior experienced in 2000)?

What were the influences of past management practices on fire behavior in 2000?

What fuel loadings and resulting fire potential exists in the near and long terms? What fuels treatments are needed, and where?

It has been predicted that wildfires will act as a large-scale disturbance process over large areas in the Intermountain West in the foreseeable future (Agee, 1993). To what extent should this be a consideration in land management planning (Quigley et al., 1997)?

How will the fire season of 2000 affect prescribed fire programs?

## 4.8.3 Historic and Pre-fire Conditions

Refer to Sections 5.5.3 and 5.5.5 for a description of historic and pre-fire conditions.

## 4.8.4 Effects and Implications of the Fires of 2000

Fires during the summer of 2000 became large and intense because of the numerous fire starts, fuels arrangement, overstocking, lack of fire suppression resources, and severe drought conditions. When the Bitterroot National Forest was experiencing its worst fires, the Salmon, Beaverhead-Deerlodge, and Helena National Forests were also burning, as were other areas around the country. Firefighting resources were stretched thin. Resource placement was prioritized depending on the need for protection of whole communities rather than single structures, indicating the magnitude of these events.

One of the results of the fires of 2000 is the creation of a future problem with fuels. Standing dead trees will eventually fall over and pile up on the forest floor if no action is taken to reduce them. Because of the dry climate, these large fuels will not decay

rapidly and will most likely remain on the landscape until it burns again. When these areas burn again, heat from the large fuels in direct contact with the ground could have severe effects on soils. A series of re-burns of abnormal severity and duration may occur until fuel loadings reach a more historic level.

In general, it appears that fires on the Bitterroot National Forest and throughout the West are becoming larger, more destructive, and more resistant to control actions. Increased human habitation of forested lands is a contributing factor. In the Bitterroot Valley, many people wish to live in the lower elevations immediately adjacent to VRU 2 lands. Most people want trees on their property for screening and seclusion. There are few fuel breaks of sufficient size to stop fires or provide an anchor for suppression actions.

The social atmosphere affects activities on public lands also. Many people do not want management activities to occur on public lands adjacent to their property. The forest they see appears "natural" to them, and many are not aware of the potential fire hazards associated with their surroundings. The individuals living in these areas need to be informed, prepared, and willing to accept the consequences and trade-offs of living in these fire environments. They need to understand the importance of maintaining their environment in a condition that is not as vulnerable to fires.

The fires of 2000 had the greatest impact on VRU 2 (warm, dry ponderosa pine/Douglas-fir). High intensity fire killed most of the understory of Douglas-fir and small diameter ponderosa pine. More large-diameter ponderosa pines were killed than likely would have been under pre-settlement conditions.

The ecosystems at greatest risk are those associated with VRU 2. The fires that affected these areas burned hot enough to kill even the largest ponderosa pines which are very fire tolerant. Post-fire fuels in the form of standing dead and dying trees will be a problem on these sites in decades to come. Historically, loadings of small down fuels (.25 to 6 inches in diameter) were less than 15 tons per acre. Course wood debris (CWD) guidelines have been developed to guide the amount of dead wood to retain in different VRU's. Section 4.5.7.1 describes these CWD guidelines for all of the VRU's.

## 4.8.5 Objectives and Recommendations

### *4.8.5.1 Regional Context*

The Interior Columbia Basin Ecosystem Management Plan recommendations should, however, still be incorporated in future "purpose and need" statements for vegetative treatments, including the following:

- Establish stands where the tree stocking level is consistent with inherent disturbance regime typical for the plant community.

- Treat a large portion of the analysis area where fire frequency has declined between historical and current by at least one frequency class.
- Manage fuels where fire severity has increased between historical and current periods.
- Maintain ecological integrity.
- Emphasize changes in structure and composition at the watershed level and increase diversity at this scale.

ICBEMP suggests creating forested stands at a landscape or watershed scale that exhibit high integrity. The element of high integrity include: providing consistent tree stocking levels that are typical for the forest vegetation present, limiting the amount and distribution of exotic species, providing snags and appropriate levels of down woody material, reintroduce fire and mimic its effect on the composition and patterns of forest types, and maintaining historic fire severity and frequency regimes.

### *4.8.5.2 Management Needs and Opportunities*

To ensure the perpetuation of VRU's 1 and 2 (low and mid-elevation ponderosa pine communities), it is important that fuels from the 2000 fires be reduced to more closely resemble pre-settlement levels, or less than 15 tons per acre with trees widely spaced. Prescribed burning treatments need to be implemented over time to maintain surface fuel loading at manageable levels and recycle nutrients. This would ensure that during severe fire seasons the probability of a stand replacement fire would be significantly reduced; this would also assist in the development of ponderosa pine grasslands, a habitat that has significantly declined. In treated stands where reforestation is needed, consideration for future fire occurrence should be given, and stocking should reflect the inevitable fact that fire will return to these stands before they reach rotation age. If these concepts are maintained, the potential for future large stand-replacing fires will be considerably reduced.

Map 8-1 in Appendix B, shows warm dry sites (southerly aspects below 6000 feet elevation) where fuel reduction work should be emphasized. A schedule of prescribed fire needs to be applied on these sites to reduce fuels and maintain ecosystem processes.

In VRUs 3, 4, and 5, fuel reduction projects should address the potential of re-burn. Although a natural occurrence in these ecosystems, currently the social acceptance of landscape-size fire is low. Management direction that breaks the continuity of the large tracts of standing and down fire-killed timber would reduce the potential for overwhelmingly large fires in the future, and reduce the probability of several key watersheds being severely burned at one time.

Mechanical fuel treatments and prescribed fire should be considered to reduce potential for these wildfire events. management along Forest Service system roads would provide containment lines for wildfires, holding lines for future prescribed fires, and

reduce snag hazards for forest users. Strategic ridges also should be identified and fuel reduction could be focused there for the reasons mentioned above.

In the future, the use of wildfires for resource benefits in designated areas could be considered if fuel breaks are established and approved plans are in place. This would give land managers the flexibility to use wildfire to attain resource objectives when burning conditions are not extreme.

In the urban interface, utilization of mechanical thinning and prescribed fire on a periodic basis would reduce the potential of lethal stand-replacing fires **(Figures 8-1 and 8-2, Appendix A)**. People who live in these environments must take responsibility to maintain their property in a way that reduces or eliminates damaging fires and does not put suppression forces at risk when there is a wildfire. In the immediate vicinity of urban interface zones, if and when fuel loadings allow, large scale prescribed fires could be used to maintain the sites and prepare them for the use of natural fire in the maintenance of the forest. It is important that the size of the burns be large (500 acres and up). This will keep costs down and will be more effective in slowing or stopping future large fires. Hopefully with more education, fire will become more socially acceptable with an increased awareness and understanding of fire's role in the long-term health of the forest.

In high-elevation VRUs 3 and 4, prescribed fires could be used to break up large tracts of continuous fuels to ensure that entire drainages are not burned during severe fire seasons. This is important for reducing the possibility that major portions of these habitats would be affected at one time. It also would aid in fire suppression by providing safe zones and anchor points when fires start during periods of high fire danger.

### *4.8.5.3 Recommendations*

In VRU 2, areas we reduce fuels to more closely approximate pre-settlement conditions. Once large fires are reduced, a program of prescribed fire should be applied at appropriate intervals.

Because it will be impractical to effectively reduce fuels in all the burned areas, zones with reduced fuels and more defensible fuel profile should be considered to break up fuel continuity. These could be established along system roads to provide anchor points and defensible areas to help control future fires, to insure safety of forest users, and as holding lines for prescribed fires in the future. Defensible fuel profile zones should be positioned on strategic ridges to reduce the future risk of huge conflagrations.

Use prescribed fire in higher elevation burned VRUs to reduce large tracts of continuous fuels.

Planning to allow wildfires to burn for resource benefit should be initiated on more of the Bitterroot National Forest. This will allow flexibility to use wildfires as a management tool on a case-by-case basis.

Implement fuel reduction in the urban interface. This should be a combination of mechanical and prescribed burning.

### *4.8.5.4 Opportunities to Work with Citizens, Agencies, and Research*

- ✓ Research is needed to determine the short-term and long-term potential for reburn, and future reburn effects on soils, site productivity, and vegetation succession in different plant communities. Following Beschta et al. (1995) and Everett (1995), there are no studies documenting a reduction in fire intensity in a stand that had previously burned and then been logged. Retrospective studies that look at twice-burned stands in which different levels of fuel reduction were conducted after the first fire would shed more light on the issue of post-fire logging, fuel reduction, and future reburn intensity (McIver and Starr, 2000).

- ✓ Research is needed to determine fuel accumulation rates in different types of burned stands. This topic would coincide nicely with the snag attrition rate study suggested in Section 5.4.5.3.

## 4.8.6 Regulations and Direction

The Bitterroot National Forest Plan includes forest-wide fire management direction. This direction is to ensure that fire programs are cost effective, compatible with the role of fire in forest ecosystems, and responsive to resource management objectives. This includes the use of prescribed fire to maintain healthy, ecosystems that meet land management objectives.

- ➢ Maintain an adequate cadre of well qualified prescribed fire experts to apply both technical knowledge and field experience in accomplishing prescribed fire needs.

- ➢ Emphasize fire ecology when applying prescribed fire. Use fire ecology and fire management reference documents to guide project development, execution, and evaluation. Examples are: "The Historical Role of Fire on the Bitterroot National Forest"(Arno, 1976); "Fire Ecology Investigation in Selway-Bitterroot Wilderness" (Habeck, 1972); "Fire Group Description for the Bitterroot National Forest, adapted from Fire Ecology of Lolo National Forest Habitat Types" (Davis, Clayton, Fisher, 1980), and "Revised Fuel Treatment Guides, Northern Region (USDA, 1984). Attempt to integrate an understanding of the role fire plays in regulating stand structure into development of silvicultural prescriptions.

Emphasize the use of prescribed fire in range and wildlife habitat improvement projects.

- Wildland fire will be permitted in wilderness to the extent possible within prescriptions that provide for protection of life, property, and adjacent resources.

- Prescribed fire programs will be responsive to national, state, and local air quality regulations and agreements. An active "inform and involve " program is necessary to ensure public involvement, understanding, and approval of prescribed fire programs.

- Vegetation treatments using wildland and prescribed fire is allowed by the Bitterroot National Forest Plan. On a majority of the land base of the Forest. Fire has been recognized as a valuable tool for the reduction of fuels generated from harvest activities. These treatments include broadcast burning, underburning, jackpot burning, and machine and handpile burning. They also has been identified as necessary in the management of natural fuels.

Additional direction for managing National Forest System lands comes from the Forest Service's Washington Office in the form of the Chief's direction on Ecosystem Management Additional guidance is provided in the findings of the science documents and the Environmental Impact Statement for the Interior Columbia River Basin Project.

Specific guidelines for fire use are found in Forest Service Manual 5100 (Fire Management) and a number of Forest Service Handbooks resulting from FSM 5100 direction. Forest Service Handbook 5109.19 (Fire Management Analysis and Planning) gives specific direction on planning practices related to Fire and Fuels management. The "Wildland and Prescribed Fire Management Policy", August 1998, is an interagency guide established to standardize procedures for implementation of the Federal Wildland Fire Policy and Program Review 1995.

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# Appendix A. Photos

**Figure 8-1.** Douglas-fir encroachment in the urban interface in the Lost Horse drainage.

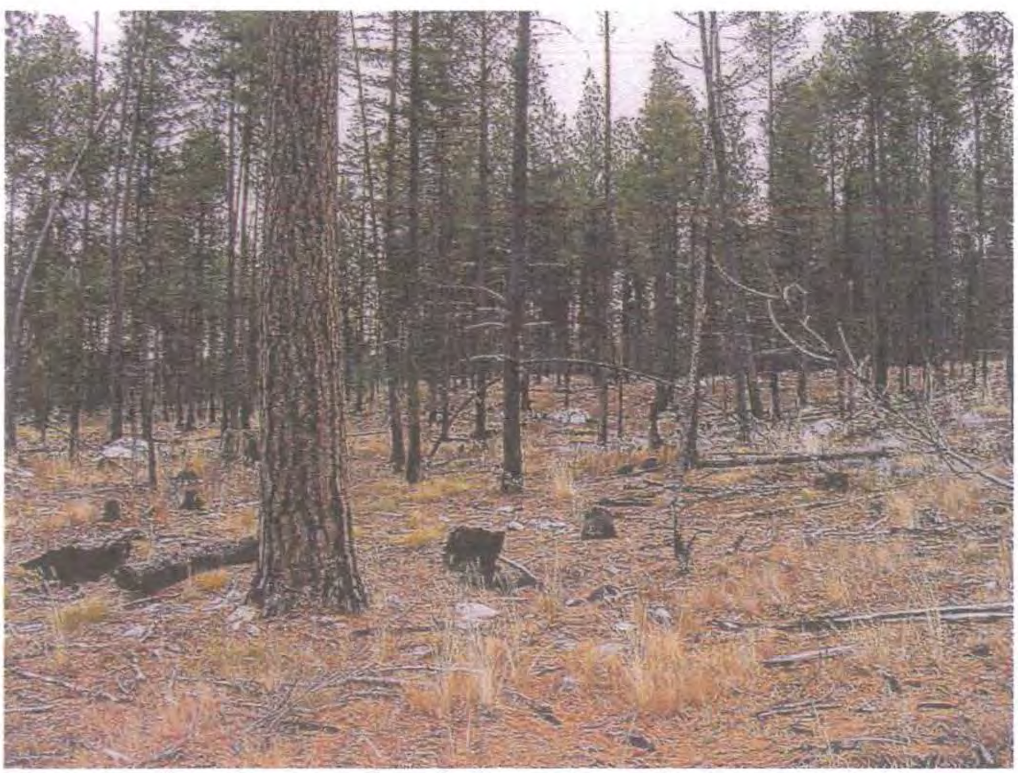
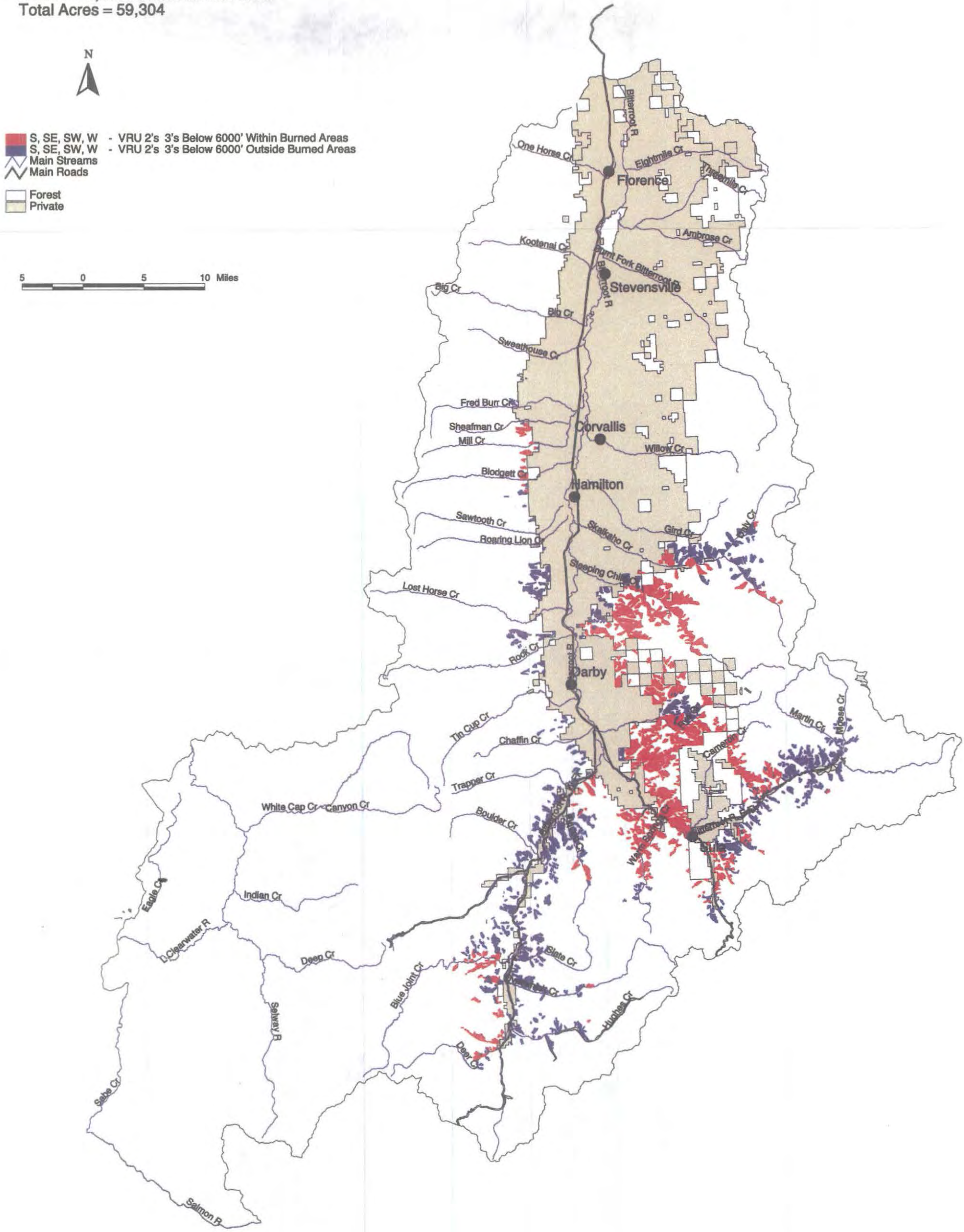


**Figure 8-2.** Interface area where fuels were treated with mechanical harvest and underburning.

Map 8-1 Potential Maintenance Burn Sites
Bitterroot National Forest
Acres = 32,924 within burned area
Acres = 26,380 outside burned area
Total Acres = 59,304



# 4.9 Fire and Fuels in the Wildland-Urban Interface

## 4.9.1 Introduction

The Bitterroot National Forest's Fire Management Plan divides the Forest into several Fire Management Zones (FMZs). The wildland-urban interface zone (outside wilderness), or FMZ1, consists of one-mile-wide buffers along private lands on the east and west sides of the Bitterroot Valley and the corridors of the East and West Forks of the Bitterroot River (see Map 9-1 in Appendix B). FMZ1 includes those areas where the threat to life and private property from wildland fire is high, and resource values (scenery, wildlife, etc.), are high.

Risk of property loss is high in these areas. As settlement adjacent to public land continues, the risk will increase. The Fire Management Plan's prescribed response to wildfire in FMZ1 is suppression using rapid, aggressive initial attack actions. During multiple-fire situations, this zone is the highest priority 1 for assigning suppression resources (**Map 9-1 and Figure 9-1, Appendix A**).

## 4.9.2 Fire and Fuels Issues in the Wildland-Urban Interface

- What are appropriate uses of prescribed fire and fuel treatments in FMZ1?
- How can the effects of fire be replicated in FMZ1 in a way that is socially and environmentally successful?
- How should areas be prioritized for prescribed fire and fuel treatments in time and space?
- How should silvicultural treatments be incorporated into fuels treatments?
- How can we increase the safety of firefighters and the public during wildland fire in FMZ1?
- What future re-burn potential exists in areas of the wildland-urban interface burned during the fires of 2000?

## 4.9.3 Historic and Pre-fire Conditions

### *4.9.3.1 Forested Plant Communities – Historic Conditions*

Vegetation in the Bitterroot Valley's wildland-urban interface consists primarily of grasslands (VRU 1) and warm, dry ponderosa pine/Douglas-fir vegetation types (VRU 2). These two VRU's are the main concern in fire and fuels management in the interface. Grasslands are discussed in Section 5.7. VRU 2 occurs on steep, dry breaklands and benches. At higher elevations, these landforms support Douglas-fir. At lower elevations, the forest consists of mixed Douglas-fir and ponderosa pine.

The following information on fire frequency and intensity in VRU's 1 and 2, is based on "Fire Ecology of Western Montana Forest Habitat Types" (Fischer and Bradley, 1987).

> Before fire suppression began, fires were generally frequent and non-lethal, with a relatively uniform pattern. Fires occurred, on average, every 5 to 25 years. Forest stands

> Before fire suppression began, fires were generally frequent and non-lethal, with a relatively uniform pattern. Fires occurred, on average, every 5 to 25 years. Forest stands were generally open and park-like, consisting of multi-storied and multi-aged ponderosa pine with Douglas-fir at higher elevations.
>
> Ground fires occurred frequently on warm, dry sites, and on moderately warm, dry sites with low relief. The fires consumed ground fuels, thinned out Douglas-fir and lodgepole pine in the lower tree canopy, and killed the occasional overstory tree or small group of overstory trees. These frequent, low-intensity fires perpetuated an open forest with single- or multi-storied structure. Forest structures and composition were maintained, and insects and diseases were kept at low levels.
>
> Periodically these burning events coincided with cone production in the overstory trees, resulting in a new crop of seedlings. The frequent burning also occurred when these small trees were susceptible to fire, and "thinned" the understory to relatively low densities. While small ponderosa pine can tolerate low-intensity ground fires at intervals as short as 6 years, Douglas-fir is susceptible during the seedling and sapling stages due to thin bark and resin blisters. Consequently, the stands generally had a higher percentage of ponderosa pine than Douglas-fir **(Figure 9-3, Appendix A)**.

The ground fires produced occasional openings. If the openings were not large enough for establishment and growth of seedlings, the surviving overstory trees rapidly grew to fill the available space (Oliver and Larson, 1996). Mixed or crown fires occurred every 50 to 500 years on moderate sites, but on the driest sites more than 1000 years could pass between stand-replacing fires. For long periods of time, these forests were dominated by shade-intolerant seral species (e.g., ponderosa pine) over relatively little ground fuel. Snags occurred singly or scattered in small groups (Quigley et al., 1997; Bailey and Losensky, 1996; Fischer and Bradley, 1987). When lethal, stand-replacing crown fires did occur, they killed most of the overstory and cycled the forest back to early seral conditions. The occasional large tree that survived these rare events could persist for many decades (Quigley et al., 1997).

### *4.9.3.2 Forested Plant Communities – Pre-fire Conditions*

When the fires of 2000 began, the vegetation in the wildland-urban interface was in a very different condition than it was historically. Fire suppression, introduction of non-native vegetation, and active manipulation of vegetation by humans had combined to increase the forest's susceptibility to catastrophic wildfire. The elimination of frequent, low-intensity ground fires had a dramatic effect on both the overstory and understory vegetation. Without the fires' periodic thinning influence, the forest understory and mid-canopy shifted from scattered ponderosa pine to dense groves of shade-tolerant Douglas-fir. This change in stand structure altered fire behavior, since the dense, multi-layered forests provided an avenue for ground fires to move higher into the canopy, and ultimately into the overstory (Barrett, 1991; Agee, 1993). In addition, the elimination of frequent ground fires also allowed fine and medium-size fuels to build up, while dense stands caused an increase in tree stress mortality (Quigley et al., 1997) **(Figure 9-5, Appendix A)**.

The ecosystem functions of the wildland-urban interface forest were significantly altered from the historic condition. Nutrient exchanges, carbon and hydrologic cycles, and various wildlife habitats were all substantially different than before fire suppression began (Kimmins, 1997; Quigley et al., 1997). Due to the increased tree density, coverage of shade-intolerant shrubs and nutrient availability for tree growth and maintenance decreased, while water stress and insect/disease activity increased. In addition, root diseases are now prevalent across VRU 2, a result of the increased numbers of Douglas-fir stems.

Understory vegetation also changed, due to the elimination of fire, introduction of noxious weeds, and changes in overstory vegetation structure. A general decline of palatable forage has replaced fire-caused frequent nutrient cycling and re-sprouting of both shrubs and grasses. Old, decadent, woody stems are common, in place of the more succulent sprouts associated with repeated ground fires. Bluebunch wheatgrass (*Pseudoroegneria spicata*) can have reduced palatability if fire is excluded (Bradley, 1986). The potential for high intensity fires, beyond what would have occurred under a natural succession/disturbance regime, also increases the risk of reduced coverage of such species and thus a risk of reduced forage production for a variety of large herbivores (Bailey and Losensky, 1996).

Infestations of spotted knapweed (*Centaurea maculosa*), a Montana state-listed noxious weed, have become common in these open areas. Sulfur cinquefoil (*Potentilla recta*) exists in the lower elevations, and St. John's wort (*Hypericum perforatum*) and common tansy (*Tanacetum vulgare*) are scattered throughout as well.

#### *4.9.3.3 Smoke Management*

Air quality is an important factor in the impacts of wildland and management-ignited fire on the Bitterroot National Forest. The public tends to perceive smoke generated during wildland fire as a natural occurrence, typically unavoidable, and even though they do not like it they tend to accept that it is part of living in the Bitterroot Valley. However, smoke generated by management-ignited fire is more generally viewed as unacceptable, controllable, and an intrusion (Social Assessment of the Bitterroot Valley, Montana, 1994).

Smoke levels in the Bitterroot Valley were an estimated 1.3 times greater prior to settlement in the 1800s. The wildfire regime is now significantly different than it was historically because of increased fuel loading, development of ladder fuels, and increases in stand density. Only about 10 percent of the land sees non-lethal underburns, compared to about 31 percent historically. On a larger scale, 58 percent of the forest in the Upper Columbia River Basin now burns with a lethal (stand-replacement) fire regime, compared to 19 percent historically. Stand-replacing fires consume much more fuel and produce much more smoke than non-lethal fires.

#### *4.9.3.4 Human Element*

The population of Ravalli County, in which most of the Bitterroot National Forest is located, increased from 12,000 residents in 1960 to 36,000 in 1999. Since 1990 alone,

population in Ravalli County has increased by 43 percent (Population Division, U.S. Census, 1999). From the early part of the century through the 1970s, the economy in the Bitterroot Valley was based on natural resources: logging, mining, farming, and ranching. This progressively changed through the 1980s and 90s, and as of 1992 employment estimates showed that the number of people employed by economic sector included service, 23.6 percent; trade, 20.6 percent; government, 14.7 percent; and agriculture, 13.3 percent. As more people move into the Bitterroot Valley, recreational use of the low elevation forests can be expected to increase. Development of housing in the forested landscapes along the Bitterroot National Forest boundary will also increase. In general, settlement density decreases from north to south, with more subdivisions in the north half of the valley and more dispersed home sites, small farms, and ranches to the south (Social Assessment of the Bitterroot Valley, 1994).

The area of greatest concern is located on the west side of the valley along the base of the Bitterroot Front. Fire suppression has caused this area to develop fuel loading and stand structures that are outside the historic range of variability. Residential structure density is higher here than along other sections of the Forest boundary. Although future settlement patterns are uncertain, the number of structures in the wildland-urban interface is likely to continue to increase. Prevailing winds place these homes in the path of wildfires: west and southwest winds have historically pushed wildfires from the west Bitterroot face into the lower-lying areas. Fires of note that followed this pattern include Blodgett (2000), Ward Mountain (1994), Totem Peak and Rock Creek (1988), and Printz Ridge (1985). Numerous other fires, dating back to the first half of the 20th century, typify fire behavior in this area.

The Bitterroot National Forest developed its Fire Prevention Management Plan 2000 (before the fires) by analyzing wildland fuels, hazard, risk, value, and suppression capability. The plan is based on breakdowns for each Bitterroot National Forest Ranger District (Stevensville, Darby, West Fork, and Sula) and then further broken down by Fire Management Zones. The Compartment Assessment Rankings for catastrophic fire potential rated high for all four districts in the wildland-urban interface zone (FMZ1). Subsequently, much of the FMZ1 on Sula District burned in the summer's fires. Varying amounts of the FMZ1 on the other three districts also burned.

## 4.9.4 Effects and Implications of the Fires of 2000

### *4.9.4.1 Effects on Forested Plant Communities*

Approximately 54,300 acres of FMZ1 burned during the fires of 2000, representing 31 percent of the 179,000-acre wildland-urban interface area (Table 9-1). Approximately 16,000 acres burned at high severity, 27,000 acres at medium severity, and 11,300 at low severity. More of the area burned at high or moderate intensity than would have been typical under the historic fire regime, when most fires were of low intensity. Because of their intensity, the fires of 2000 had significant effects on private forest and residences: 70 homes, 2 commercial properties, and 167 outbuildings were destroyed **(Figure 9-4, Appendix A).**

***Table 9-1. Fire Management Zone 1 acres burned, by ownership***

| Ownership | Burned | Unburned | Total |
|---|---|---|---|
| National Forest | 47,000 | 105,000 | 153,000 |
| State/Private | 7,300 | 18,700 | 26,000 |
| FMZ1 total | 54,300 | 123,700 | 179,000 |

Five main interface areas were affected: near Blodgett Canyon, northwest of Hamilton; along the east side of the Bitterroot Valley from Skalkaho Creek to Sula; along the west side of the East Fork of the Bitterroot River from north of Conner to Sula; along the lower West Fork from Conner to Piquette Creek; and the upper West Fork from Mud Creek to near Woods Creek. Some locations experienced high-intensity crown fires that caused substantial tree mortality **(Figure 9-6, Appendix A)**.

Nearly 105,000 acres of FMZ1 on the Bitterroot National Forest did *not* burn. Much of this area is still predisposed to catastrophic wildfire, with dense stands and thickets of small trees. Stand-replacing fires occurring on a large-scale basis, as they did in 2000, are not typical of historic disturbance patterns, but could occur again because forest and fuel conditions are also far outside the historical range **(Figure 9-7, Appendix A)**.

The stands that burned will deteriorate over time and the burned trees will fall. This natural process will, however, create the potential for re-burns in the future. If the fallen trees burn, the fire could be hot and long lasting, which could kill regeneration and damage soils and watersheds.

Even if the wildland-urban interface stands are treated in some way (see Recommendations), potential will still exist for torching and stand-replacing fires on a more limited basis. They would probably result from unplanned ignitions, although they could result from management-ignited fire, and possibly even be desirable in small areas. One thing is certain: without fire and mechanical treatments designed to reduce fuels and understory vegetation, FMZ1 forests will continue to progress away from naturally occurring conditions and the threat to interface areas will only increase.

### *4.9.4.2 Effects of Smoke*

Missoula, the Bitterroot Valley, and the surrounding area experienced substantial amounts of smoke from the fires of 2000. There was nothing firefighting personnel could do to change this situation. The Valley and Missoula were "smoked-in" to varying extents for well over a month. Health alerts were issued due to heavy particulate levels and many residents chose to either stay indoors or leave the Valley temporarily due to unpleasant and unhealthy conditions.

- The Bitterroot National Forest should conduct more outreach to neighborhoods and landowners who live in the interface, and reduce fuels on National Forest land adjacent to landowners who see that work as desirable.

## 4.9.6 Regulations and Direction

The operational role of federal agencies as a partner in the wildland/urban interface includes wildland firefighting, hazardous fuels reduction, cooperative prevention and education, and technical assistance. Structural fire protection is the responsibility of Tribal, State, and local governments. Federal agencies may assist with exterior structural suppression activities under formal fire Protection Agreements that specify the mutual responsibilities of the partners, including funding. Firefighter and public safety is the first priority in every fire management activity (Wildland and Prescribed Fire Management Policy Implementation Procedures Reference Guide, 1998). With regard to fire use in the wildland-urban interface, managing fire through natural ignitions is not a decision that is currently available on the Bitterroot National Forest. Fire use via management ignitions is available with the predications that fire management planning is fully integrated into Forest NFMA and NEPA analysis; that accurate, measurable, and attainable objectives associated with the use of fire are accurately defined and disclosed; and that fuels management will be based upon ecosystem management principles, processes, and desired conditions, and analyzed at various scales (Bitterroot National Forest Plan, Appendix K-11). Within FMZ1 there are portions of Bitterroot Forest Plan Management Areas 1, 2, 3a, 3b, 3c, 5, 6, and 8, Where management-ignited fire is an allowable (Bitterroot Forest Plan 1987).

Specific guidelines for fire management are found in Forest Service Manual 5100 (Fire Management) and the 1995 Wildland and Prescribed Fire Policy. Forest-wide standards supplementing National and Regional policies, standards, and guidelines found in Forest Service Manuals and Handbooks are discussed in the Bitterroot National Forest Fire Management Plan, Appendix K-11, 2000.

Congress passed the Clean Air Act in 1967, and amended it in 1972, 1977, and 1990. The purpose of the act is to protect and enhance the quality of the Nation's air resources while ensuring the protection of public health and welfare. The Act established National Ambient Air Quality Standards, which must be met by federal agencies, states, and private industry. States are given primary responsibility for air quality management. In response to the Clean Air Act, Montana developed and implemented a State Implementation Plan and a corresponding open burning air quality rules to ensure that activities and practices complied with all the procedural and substantive requirements. The current federal and Montana and Idaho standards are: 1) over a 24 hour period, PM 10 concentrations will not exceed 150 micrograms per cubic meter; and 2) the annual arithmetic average must not exceed 50 micrograms per cubic meter. More specific and operational direction concerning smoke management is discussed in Chapter 40 of the Bitterroot National Forest Fire Management Plan.

The Code of Federal Regulations (CFR) is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the

Federal Government. 36 CFR 219.27 sets forth the minimum specific management requirements to be met in accomplishing goals and objectives for the National Forest System. With consideration to integrated resource management most of these regulations pertain in some manner to managing resources in the Wildland Urban Interface. The requirements listed below are those that most directly pertain to fire management: Section (a) Resource Protection: All management prescriptions shall (1) Conserve soil and water resources and not allow significant or permanent impairment of the productivity of the land; (2) Consistent with the relative resource values involved, minimal serious or long-lasting hazards from flood, wind, wildfire, erosion, other natural physical forces unless these are specifically excepted; (12) Be consistent with maintaining air quality at a level that is adequate for the protection and use of National Forest System resources and that meets or exceeds applicable Federal, State and/or local standards or regulations.

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# Appendix A. Photos

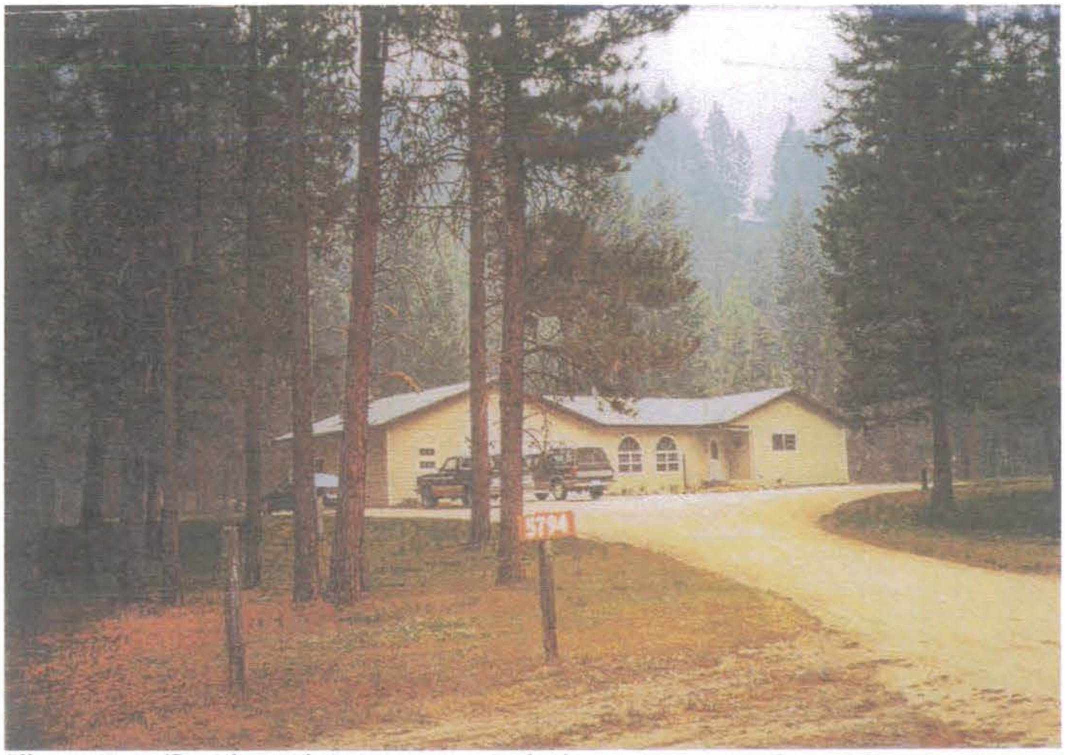


**Figure 9-1.** Residential structure typical of many areas in the wildland-urban interface in the Bitterroot Valley.

**Figure 9-2.** Fuels treatments will provide more natural, park-like stands that will allow firefighters safer opportunities during fire suppression.

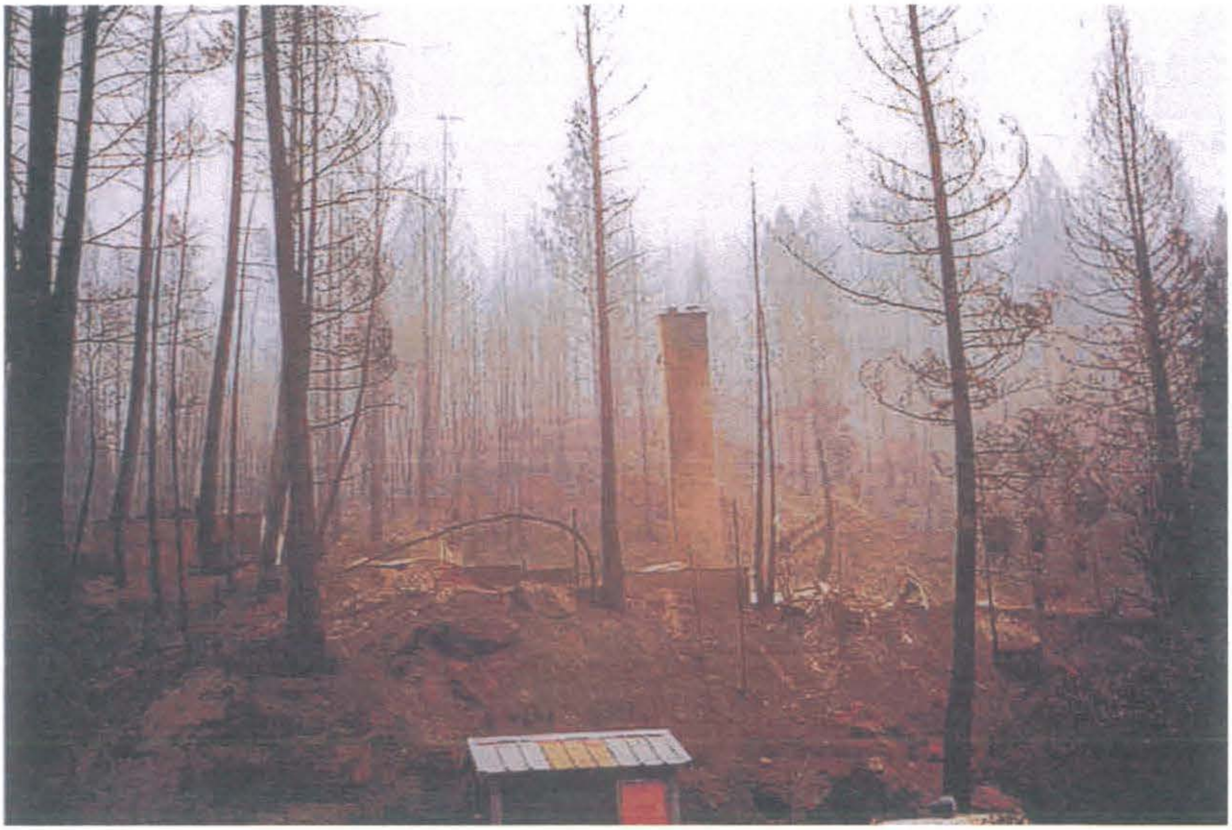


**Figure 9-3**. Residential structure destroyed during the fires of 2000.

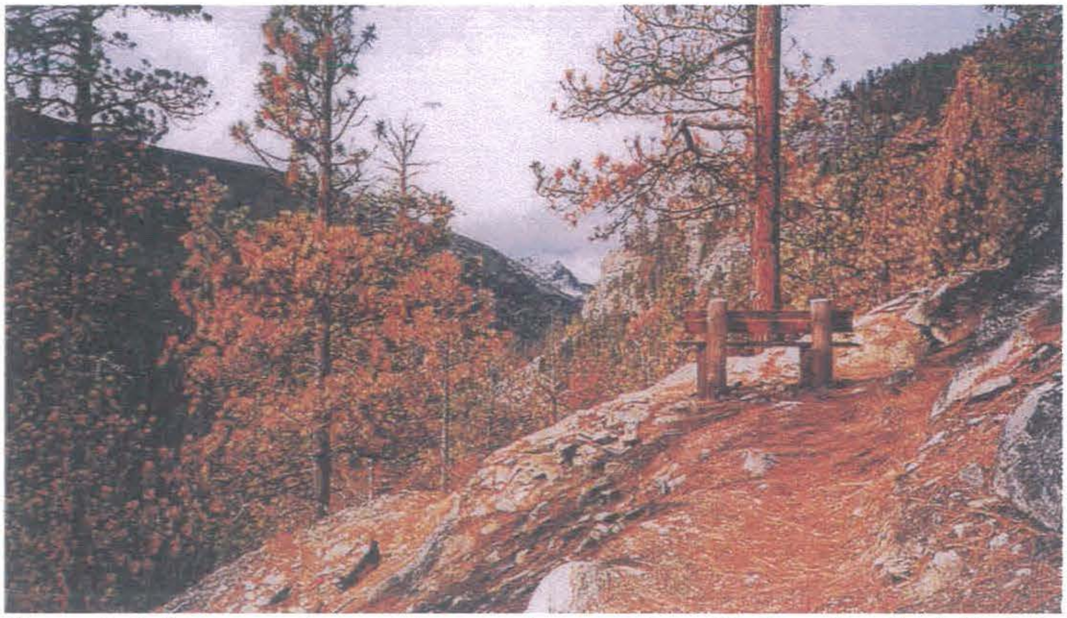
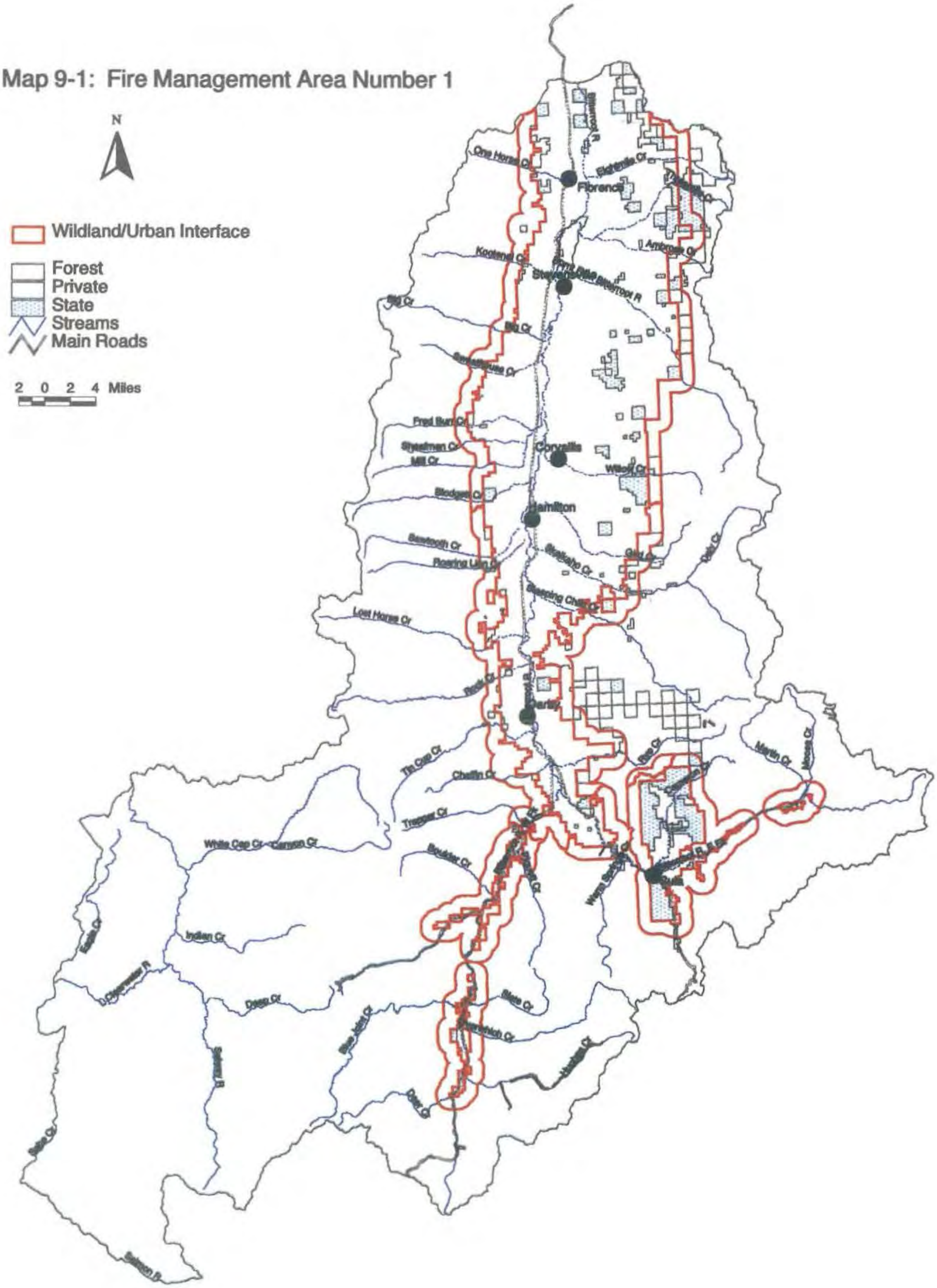
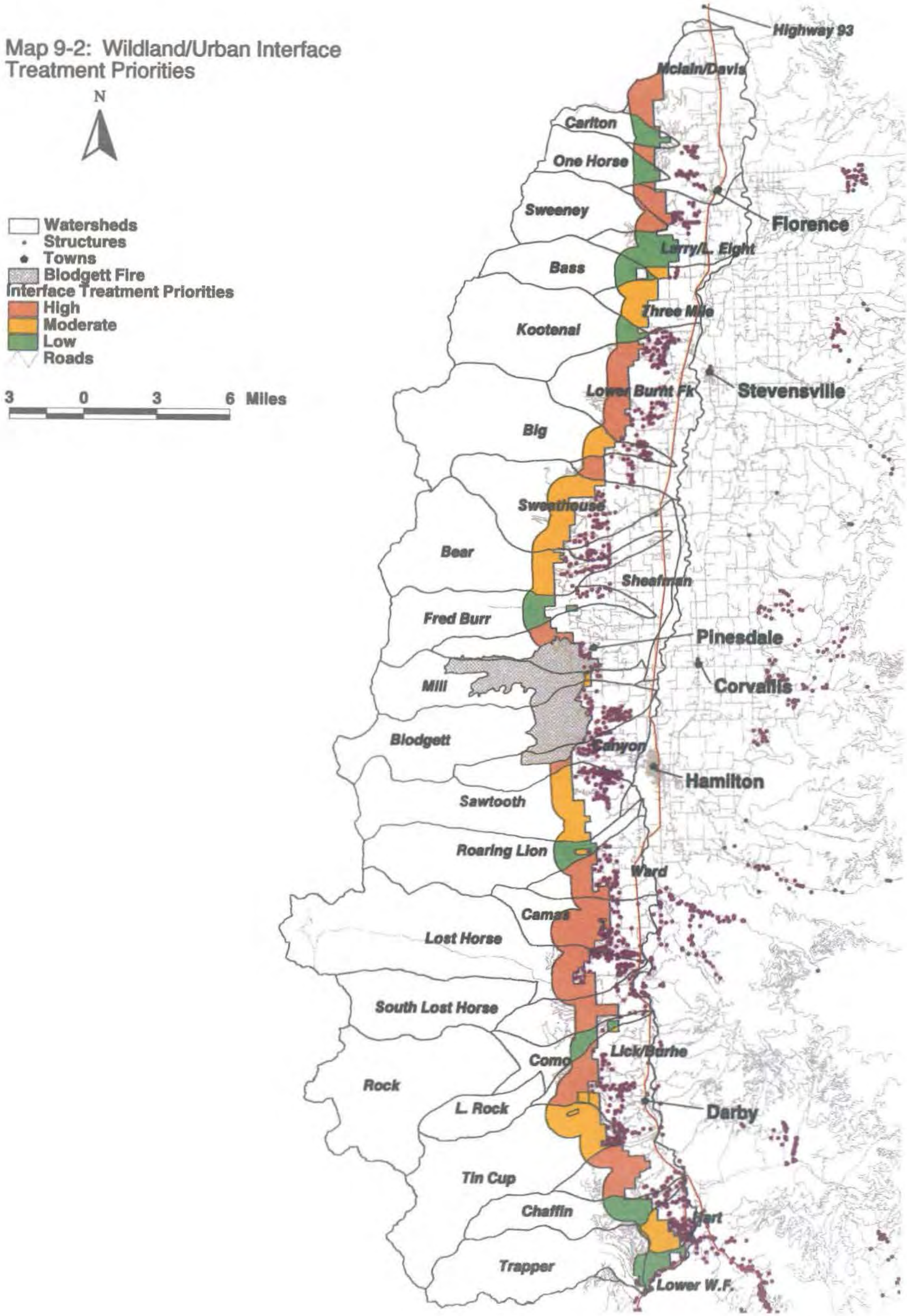


**Figure 9-4**. Large ponderosa pine trees burned along Blodgett Overlook Trail during the Blodgett Fire.

**Figure 9-5**. Ponderosa pine stand with understory and ladder fuels build-ups.

## Map 9-1: Fire Management Area Number 1




Map 9-2: Wildland/Urban Interface Treatment Priorities
N
Watersheds
Structures
Towns
Blodgett Fire
Interface Treatment Priorities
High
Moderate
Low
Roads
3 0 3 6 Miles
Highway 93
Mclain/Davis
Carlton
One Horse
Sweeney
Florence
Larry/L. Eight
Bass
Three Mile
Kootenai
Stevensville
Lower Burnt Fk
Big
Sweathouse
Bear
Sheafman
Fred Burr
Pinesdale
Mill
Corvallis
Blodgett
Canyon
Hamilton
Sawtooth
Roaring Lion
Ward
Camas
Lost Horse
South Lost Horse
Como
Lick/Barhe
Rock
L. Rock
Darby
Tin Cup
Chaffin
Hart
Trapper
Lower W.F.

# 4.10 Roads, Trails, and Travel Management

## 4.10.1 Background

The most significant physical characteristics affecting the transportation system and travel management are granitic soils and steep slopes. The relatively low standard of many existing roads and trails affects travel management options.

## 4.10.2 Issues

### *4.10.2.1 Roads*

1. Flooding could cause major road damage to roads such as North Fork of Rye (FR 321) and Laird Creek(FR 370).
2. Long-term maintenance costs will increase due to bank sloughing, increased runoff/erosion, and falling snags.
3. The risk will increase for cut and fill slopes to fail and culverts to become plugged.
4. The problem of bank slough on gravel roads will result in contamination and loss of gravel.
5. A good road system will be needed for rehabilitation work.
6. Private roads on former Darby Lumber lands may impact National Forest roads down slope.
7. Burnout of buried slash in some road fills will result in settling of the road surface.
8. Improved surface drainage and gravel may be needed on roads used for rehabilitation as well as roads with high public use.

### *4.10.2.2 Trails*

1. Long-term maintenance will increase due to bank slough and falling snags. Erosion problems will increase.
2. Some trails will require reconstruction and/or relocation **(Figure 10-1, Appendix A)**.
3. Some low use trails would require substantial maintenance or reconstruction costs. These costs need to be weighed against the benefits provided by having them on the Forest's trail system.

### *4.10.2.3 Key Issues to Focus On*

1. Provide for adequate intermediate term maintenance of roads & trails.
2. OHV use in burned areas and re-evaluate road/trail use restrictions.
3. Capital investment funds for road and trail reconstruction/relocation.

## 4.10.3 Historic and Pre-fire Conditions

Pre-fire conditions in the burned area were similar to current conditions in the unburned areas of Fire Management Zone 1. Roads and trails now threatened with flood damage had some risk before the fires, but it was much lower than now. Slopes were fairly well vegetated, so slough and slope failure were less of a risk. Erosion and falling trees were less of a problem.

## 4.10.4 Effects and Implications of the Fires of 2000

**General current conditions**. In general, the fires did not heavily damage roads and trails. A few plastic culverts were burned, some aluminum pipe was damaged, wooden water bars were damaged or destroyed on both roads and trails, and vegetation in or under fills burned out, leaving holes. Increased surface and bank slough erosion and down trees can be expected in future years. Increased risk of flooding or erosion exists on roads and trails next to streams. There is a great increase in risk of plugging and overtopping of culverts.

**West Fork.** Similar to general conditions described above.

**East Fork.** Due to large areas of very hot burn, roads along Laird Creek, Robbins Gulch, Reimal Creek, and Meadow Creek are at increased risk of flood damage.

**Rye/Sleeping Child/Skalkaho.** Due to large areas of very hot burn, roads along the North Fork of Rye Creek, Rye Creek, and upper Skalkaho Creek are at increased risk of flood damage.

**Canyon/Blodgett/Mill/Sheafman**. Similar to all burned area, except that there are only a few miles of roads and trails in this area.

**Green Interface (Fire Management Zone 1).** There is no change in this area due to fires. Most of this area has roads systems within or close to it, with the major exception of a few mountain slopes on the west side of the Bitterroot Valley. In general, the roads and trails are adequate for current use, but surfaces are often rough and drainage improvements are needed. For some roads and trails, increased public use is creating the need for reconstruction to improve safety.

## 4.10.5 Objectives and Recommendations

### *4.10.5.1 Objectives*

**Roads.** All roads have stable cut and fill slopes with adequate vegetation to minimize erosion. Drainage structures are adequate to handle surface runoff and stream flows, and will be adequately maintained. Roads will have a maintainable surface suitable for the intended users. Gravel is placed on roads where needed to reduce erosion and/or provide a better surface for users. Erosion from roads is minimized and most sediment produced will be trapped before reaching stream channels. Widths, passing areas, sight distance, and signing will be adequate for safe use by the intended user.

**Trails.** All trails are located, constructed, and maintained to provide adequate travel routes for the intended users. Drainage is adequate to minimize erosion and keep sediment out of stream channels. Maintenance is adequate to keep trails free of obstacles and ensure a stable tread with adequate width. Signing is adequate to inform and guide the user.

**Travel management.** A complete evaluation of demands and opportunities on the Bitterroot National Forest is prepared and a decision made on appropriate uses for all areas and travel routes. Detailed, easy-to-use maps are prepared, and adequate on-the-ground signing done to inform users of opportunities and restrictions. Use is appropriate for road, trail, and land conditions. Roads, trails, and/or travel routes that are not needed or cannot be maintained properly are closed. New travel routes are established where needed to improve the system and tie routes together.

### *4.10.5.2 Recommendations*

Roads. Gravel the following road segments in and near burned areas. Construct dive-through drainage dips and other road drainage features as needed. The total length of recommended gravel is 63 miles.

| | | |
|---|---|---|
| Rd. 736 | 0.1 miles | Gravel the approaches to the Blodgett Creek bridge. |
| Rd. 735 | 0.7 miles | Gravel from Rd. #736 to Hidden Meadow Lane. |
| Rd. 1365 | 3.5 miles | Gravel from Buckhorn Saddle to the switchback in S 10. |
| Hwy #38 | 3.0 miles | Gravel or pave from end of existing pavement to Rd. 711. |
| Rd. 711 | 1.7 miles | Gravel the first 1.7 miles from the Hwy #38 junction. |
| Rd. 75 | 8.0 miles | Gravel from Hwy #38 to South Fork Skalkaho Creek in S 8. |
| Rd. 75 | 7.0 miles | Gravel from FS boundary to Rd. 75 bridge on Rye Creek. |
| Rd. 75 | 3.3 miles | Gravel from Rd. #369 to Rd. #5778. |
| Rd. 321 | 7.0 miles | Gravel from FS boundary to Cold Spring Hill in S 35. |
| Rd. 5612 | 0.5 miles | Gravel all stream crossings. |
| Rd. 446 | 0.1 miles | Armor the ford of Robbins Gulch with rock. |
| Rd. 311 | 2.0 miles | Gravel from Rd #75 junction to D2/D3 boundary. |
| Rd. 311 | 1.0 miles | Gravel all stream crossings. |
| Rd. 311 | 3.0 miles | Gravel from East Fork Hwy to Guide Saddle. |

| | | |
|---|---|---|
| Rd. 5745 | 0.6 miles | Gravel from Rd. #311 to 2% Saddle. |
| Rd. 369 | 0.7 miles | Gravel from Rd. #311 to Weird Tom road. |
| Rd. 723 | 2.5 miles | Gravel from FS boundary to the switchback in S 21. |
| Rd. 725 | 2.5 miles | Gravel from milepost 3.0 to milepost 5.5. |
| Rd. 725 | 1.5 miles | Gravel from Meadow Creek crossing to Rd. #725-B. |
| Rd. 725-B | 1.5 miles | Gravel from Rd. #725 to Rd. #5740. |
| Rd. 5758 | 0.1 miles | Gravel the approaches to the Meadow Creek bridge. |
| Rd. 5759 | 0.3 miles | Gravel from Meadow Creek bridge to switchback in S 10. |
| Rd. 5764 | 0.5 miles | Gravel from Rd. #725 to Swift Cr trailhead. |
| Rd. 5753 | 0.3 miles | Gravel turnpiked section below Mink Creek Saddle. |
| Rd. 727 | 2.5 miles | Gravel from Reimel Creek crossing to end of road. |
| Rd. 106-A | 0.2 miles | Gravel the draw crossings near the south end of this road. |
| Rd. 728 | 3.5 miles | Gravel the first 3.5 miles from U.S. Hwy 93. |
| Rd. 5732 | 0.4 miles | Gravel from Rd #370 to the switchback in S 4. |
| Rd. 5767 | 1.0 miles | Gravel all stream crossings. |
| Rd. 49 | 1.0 miles | Gravel from West Fork Hwy to Piquett Creek bridge. |
| Rd. 5720 | 0.1 miles | Gravel the approaches to the Piquett Creek bridge. |
| Rd. 731 | 0.1 miles | Gravel approaches to East Fork Piquett Creek crossing. |
| Rd. 1133 | 2.0 miles | Gravel from West Fork Hwy to the switchback in S 36. |
| Rd. 13833 | 0.1 miles | Gravel the approaches to the Slate Creek bridge. |
| Rd. 5685 | 0.1 miles | Gravel the approaches to the Hughes Creek bridge. |
| Rd. 5688 | 0.1 miles | Gravel the approaches to the Hughes Creek bridge. |
| Rd. 5699 | 0.1 miles | Gravel the approaches to the Overwhich Creek bridge. |
| Rd. 5703 | 0.1 miles | Gravel the approaches to the Overwhich Creek bridge. |
| Rd. 5662 | 0.1 miles | Gravel the crossing of Coal Creek in S 20. |
| Rd. 5656 | 0.1 miles | Gravel the approaches to the Blue Joint Creek bridge. |

Trails. Reconstruct and/or conduct post-fire maintenance on the following trails. The total estimated trail length needing work is about 194 miles. We expect to find additional tread damage in the burned areas next spring due to soil instability.

| | | |
|---|---|---|
| Blodgett | Trail 19 | 2 miles |
| Mill Creek | Trail 364 | 9 miles |
| Reimel-Tolan Divide | Trail 78 | 5.5 miles |
| Reimel Creek | Trail 175 | 4.7 miles |
| Porcupine Saddle | Trail 196 | 0.7 miles |
| Warm Springs Ridge | Trail 177.1 | 4.5 miles |
| Warm Springs Ridge | Trail 177.2 | 4 miles |
| Medicine Point | Trail 181 | 2 miles |
| Andrews Creek | Trail 178 | 1 mile |
| Shields Creek | Trail 673 | 0.5 miles |
| Fire Creek | Trail 404 | 4.6 miles |
| Kent Lake | Trail 83 | 1 mile |
| South Fork Sleeping Child | Trail 84 | 4 miles |
| Skalkaho-Sleeping Child Divide | Trail 87 | 1.5 miles |

| | | |
|---|---|---|
| Sleeping Child Creek | Trail 105 | 4 miles |
| Divide Creek | Trail 159 | 1 mile |
| Bald Top-Sleeping Child | Trail 160 | 2.5 miles |
| Bald Top | Trail 161 | 2 miles |
| Little Sleeping Child | Trail 164 | 4.2 miles |
| White Stallion | Trail 288 | 2 miles |
| Sleeping Child-Divide | Trail 104 | 4.5 miles |
| Bitterroot-Rock Creek Divide | Trail 313 | 2.5 miles |
| Rye Creek-Hot Springs | Trail 504 | 6.6 miles |
| JC Recreation | Trail 1 | 2 miles |
| Continental Divide NST | Trail 9 | 10 miles |
| Clifford Creek | Trail 169 | 3 miles |
| Swift Creek | Trail 170 | 1 mile |
| Meadow-Bugle | Trail 171 | 1 mile |
| Elk Ridge | Trail 172 | 0.5 miles |
| Buck Creek | Trail 198 | 6 miles |
| Bitterroot-Rock Creek Divide | Trail 313 | 2.5 miles |
| Hidden Lake | Trail 401 | 1 mile |
| Tolan-Reimel Cutoff | Trail 403 | 4.7 miles |
| Hope Lake | Trail 424 | 1 mile |
| East Fork | Trail 433 | 9 miles |
| Hole in the Wall | Trail 434.2 | 1 mile |
| Meadow Creek Ridge | Trail 462 | 4 miles |
| Goldpan-Cross Country | Trail 89 | 4 miles |
| Langdon Point | Trail 74 | 4 miles |
| Flat Creek | Trail 7 | 4 miles |
| Nez Perce Indian | Trail 13 | 4.5 miles |
| Salamander Ridge | Trail 27 | 4 miles |
| Spot Mountain | Trail 3 | 2 miles |
| Shoup-Elk City | Trail 19 | 9 miles |
| Taylor Creek | Trail 182 | 6 miles |
| Razorback Ridge | Trail 106 | 4 miles |
| Piquett Creek | Trail 675 | 1 mile |
| Piquett Ridge | Trail 676 | 2 miles |
| Chicken Creek | Trail 138 | 6 miles |
| Drop Creek | Trail 248 | 4 miles |
| Wiles Creek | Trail 56 | 2 miles |
| Deer Creek | Trail 139 | 2 miles |
| Sawdust Gulch | Trail 512 | 1.7 miles |
| Cross Country | Trail 510 | 13 miles |

**Travel Management.** Complete a forestwide Travel Management evaluation with a decision on all travel routes and areas. Prepare detailed, easy to use maps, and adequately sign all travel routes to inform users of opportunities and restrictions.

## 4.10.6 Regulations and Direction

The Bitterroot Forest Plan (USDA Forest Service, 1987) and Forest Service Manuals 2350 (July, 1994) and 7700 (August, 2000) provide the standards and guidelines for the planning, design, construction, and maintenance of the forest road and trail system.

## 4.10.7 Literature Cited

Forest Service Manual 2350. Recreation, Wilderness, and Related Resource Management. July 8, 1994. USDA Forest Service, Washington D.C.

Forest Service Manual 7700. Transportation System. August 24, 2000. USDA Forest Service, Washington D.C.

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## Appendix A. Photos

**Figure 10-1.** Trail tread damage in severely burned area.

# 4.11 Infrastructure

## 4.11.1 Introduction

National Forest infrastructure in or near the burned areas includes:

- Administrative buildings, such as Forest Service offices, residences, warehouses, storage buildings, fire towers, and remote guard stations
- Trapper Creek Job Corps Center
- Recreation rental buildings, developed campgrounds, day use sites, and fences
- Lost Trail Ski Area (operates under a special use permit)
- Road and trail bridges
- Traffic control, directional, interpretive, and informational signs
- Forest boundary signs and corner monuments
- Communication sites
- Water and wastewater systems
- Irrigation ditches
- Range fences
- Forest administrative support sites, such as gravel pits and storage yards

Some of the administrative and recreation buildings and trails have historic significance. Roads and trails are discussed in Section 5.10.

## 4.11.2 Issues

- What criteria should be used to prioritize rehabilitation of Forest infrastructure?
- Where should rehabilitation efforts be focused?
- Why is the infrastructure important to the public?
- Should damaged or lost infrastructure be restored to its pre-fire condition?
- What effects will these fires have on the infrastructure?

## 4.11.3 Pre-fire Infrastructure Conditions

The condition of infrastructure on the Bitterroot National Forest was in the process of being assessed through Deferred Maintenance surveys before the fires. In many cases, there was a backlog of maintenance needs that was only exacerbated by the fires. Features such as communications sites and boundary posting were operating at the standard necessary to ensure employee and public safety and support management operations.

## 4.11.4 Effects and Implications of the Fires of 2000

### *4.11.4.1 Forest-wide Effects*

Site-specific details are included in Burned Area Emergency Rehabilitation (BAER) reports for the five complexes.

Damage or destruction of infrastructure such as bridges, fire towers, and signs could pose a risk to health and safety. The most pressing needs have been addressed through BAER work on roads.

**Administrative sites.** The Sula Peak Lookout was the only administrative building lost to the fires **(Figure 11-1, Appendix A)**. The tower was constructed in 1957 and was staffed right up until it burned. It covered detection areas not covered by neighboring lookout towers, including Lost Trail Pass, the Highway 93 corridor from Lost Trail Pass to the West Fork drainage, up the East Fork, and lower Rye Creek.

**Bridges.** A few bridges on private land were damaged directly by the fires or by fire suppression efforts. No damage is known to have occurred to National Forest road or trail bridges. A number of bridges on private and state land, and a few on National Forest land, are at risk of failure from post-fire debris flows. Burned Area Emergency Rehabilitation to minimize those risks has been completed.

**Signs.** Many signs were damaged or destroyed. A complete inventory has not yet been conducted.

**Landline location.** Table 11-1 shows miles of landline boundary and number of section corners damaged or destroyed **(Figures 11-2, 11-3, Appendix A).**

***Table 11-1. Land line boundaries and corners damaged or destroyed***

| Fire or complex | Posted boundary | Posted section corners |
|---|---|---|
| Blodgett | 6.00 miles | 18 |
| Skalkaho | 23.75 miles | 83 |
| Valley | 64.25 miles | 265 |

**Communication sites.** The Sula Peak Lookout housed a Forest Service radio repeater as well as a Ravalli County Sheriff's Department repeater. The repeaters are necessary for public health and safety.

**Range fences.** Many miles of range fence were burned during the fires. Roughly 70 miles of fence need to be replaced.

**Campgrounds and day use sites.** The fires affected five National Forest campgrounds. Most of the damage consisted of burned brush with some signs, barrier posts, and fences burned as well. Some trees were killed in the Warm Springs campground. Three day use sites sustained similar types of damage.

**Cabin rentals.** Several recreation rental sites were at risk during the fires, but apparently none sustained any damage.

**Lost Trail ski area.** The Full Circle fire that burned in the Saddle Mountain area affected the Lost Trail Ski Area. The fire burned into the planned expansion area, and some lift towers that had not yet been erected were burned over and sustained some paint damage. Two large Forest Service interpretive signs at the top of the mountain near the expansion were also lost. Construction in the expansion area was delayed about one month. There are roughly five acres of burned hazard trees now associated with the ski area.

**Irrigation ditches.** Below the Blodgett fire there are several irrigation ditches that could be affected by increased runoff or debris flows. These irrigation ditches sustained some damage from fire suppression activities. There is at least one irrigation ditch in the Sula area that crosses National Forest lands in several places and may have been used during suppression activities. This ditch was repaired during the suppression rehabilitation efforts.

### *4.11.4.2 Skalkaho Area*

Nine homes are at risk of increased flooding and debris flows. Areas of specific concern include the Sleeping Child Hot Springs sub-watershed, where Sleeping Child Hot Springs (a domestic water supply) and Ravalli County road 273 are threatened. Road 273 is also threatened in the Sleeping Child watershed. State Highway 38 is threatened at Newton Gulch. Structures at risk in the Little Sleeping Child Creek watershed include a State of Montana "high hazard" dam and houses downstream from the dam, as well as roads, bridges, and trails. The Skalkaho Creek Ranch house is at risk and four bridges in the Skalkaho area may be at risk. The Natural Resources Conservation Service (NRCS) identified several other homes, outbuildings, barns, and facilities that are considered at risk. Seventeen and a half miles of previously unposted boundary and 48 previously unposted corners are now needed to support fire rehabilitation efforts.

### *4.11.4.3 Rye Creek/Burke Gulch Area*

The NRCS evaluated private lands and found that 9 homes, 2 outbuildings, and 12 other structures are at risk from future flow events. Another 19 homes were evaluated and found not to be at risk from future flow events. Three bridges on the main branch of Rye Creek and eight bridges on the North Fork of Rye Creek were determined to be at risk. A United State Geological Survey (USGS) gauging station on Rye Creek is also considered to be at risk.

### *4.11.4.4 Blodgett Area*

The houses, roads, fences, and ditches below the Blodgett fire are generally buffered from the steep, severely burned areas by low-intensity burn and gently sloped alluvial fans. An exception is the road network (Forest Roads 438 and 3130), which crosses several high-intensity burn areas and is now susceptible to ditch and culvert washout. BAER efforts focused on upgrading culverts on those roads. One mile of previously unposted boundary and one previously unposted corner are now needed to support fire rehabilitation efforts.

### *4.11.4.5 Lower East Fork Area (Valley Phase I)*

The Valley complex burned 64 homes and threatened 1,070. According to the NRCS, there are 25 homes, 13 outbuildings, and 14 ponds on private land at risk from future flow events. Another 95 homes were evaluated and found not to be at risk from future flow events. Over seventy-five miles of previously unposted boundary and 194 previously unposted corners are now needed to support fire rehabilitation efforts.

### *4.11.4.6 East Fork Area*

Several homes, bridges, and one campground (Jennings Campground) are at risk in the East Fork of the Bitterroot River drainage.

### *4.11.4.7 West Fork Area*

Specific features threatened in this area include several buildings, an irrigation facility, the Painted Rocks Reservoir, State Highway 473, and County Road 104. Slate Creek Campground, two bridges on Piquett Creek, three bridges at Overwhich Creek, and one bridge at Slate Creek are at risk.

### *4.11.4.8 Wilderness*

Structure protection was implemented on seven remote guard stations and lookout towers. These efforts were successful, although the historic Magruder Ranger Station sustained some water damage.

## 4.11.5 Objectives and Recommendations

Priority for rehabilitation of infrastructure should be placed on insuring health and safety – for example replacing fire towers, certain signs, or reestablishing communications sites. Immediate needs are being addressed through BAER work on roads.

Other infrastructure restoration should be coordinated in conjunction with the fire recovery work necessary for the natural resources. For example, land line restoration will be prioritized based on planned fire prevention activities in the urban interface.

Fuel treatments in the urban interface may need to be focused along roads and trails or other developed sites where human activity is concentrated. Facilities that remain, in unburned areas, may be at risk and should be evaluated in terms of defensibility., particularly remote guard stations, lookouts, developed recreation sites, and recreation rental cabins.

**Administrative Buildings/Sites** – Sula Peak Lookout: The Forest would see an increased benefit to health and safety through the reconstruction of the Sula Peak Lookout.

**Bridges** – Following the BAER teams' recommendations to consider removal of bridge superstructures on identified "at risk" bridges, the Regional Bridge Engineer, John Kattell, completed a site inspection at these bridges. His report is on file at the Bitterroot National Forest Supervisor's Office in Hamilton. He looked specifically at hydraulic capacity, potential scour problems, vertical clear height, and the feasibility of removing the bridge superstructures. He determined that removal of the superstructures is possible, but difficult. In addition, if the superstructures are removed, the vulnerability of the abutments to damage as a result of flooding would be increased. He recommended that none of the bridge superstructures be removed. In the event of a severe flood, the bridges and associated roads will need to be monitored.

**Signs, Gates, Cattleguards** – Traffic control and directional signs will need to be replaced for public safety reasons, and will be the priority over interpretive or informational signs. Sign replacements should begin in 2001. Several gates and cattleguards will need repairs.

**Land Line Location** -

Within the Blodgett fire perimeter, 6 miles of previously surveyed and posted boundary, and 18 previously recovered or established, monumented corners need rehabilitation as a result of fire damage or loss. One mile of previously unsurveyed boundary and 1 previously unrecovered, unmonumented corner are now needed to support the fire rehabilitation effort.

Within the Skalkaho fire perimeter, 23.75 miles of previously surveyed and posted boundary, and 83 previously recovered or established, monumented corners need rehabilitation as a result of fire damage or loss, and 17.5 miles of previously unsurveyed boundary and 48 previously unrecovered, unmonumented corners are now needed to support the fire rehabilitation effort.

Within the Valley fire perimeter, 64.25 miles of previously surveyed and posted boundary, and 265 previously recovered or established, monumented corners need rehabilitation as a result of fire damage or loss, and 75.25 miles of previously unsurveyed boundary and 194 previously unrecovered, unmonumented corners are now needed to support the fire rehabilitation effort.

The cost to reestablish previously surveyed and posted boundary and monumented corners would be $248,390, while the cost to survey and post the previously unposted boundary and unrecovered, unmonumented corners would be $393,390, for a total of $641,780.

**Communication Sites** – Both the Forest Service radio repeater and the Ravalli County Sheriff's repeater, which were destroyed at Sula Peak, are necessary for public health and safety and need to be replaced.

**Range Improvements** – Although some of the burned range fence is still operable, a rough estimate is that approximately 70 miles need to be replaced. At least 10 water developments were destroyed or damaged by the fires, and need repaired or replaced. Monitoring and maintenance needs will increase as well, with a higher number of snags falling on the fences in the coming years. An estimate to complete this work is $375,000.

**Other Infrastructure** - Privately owned fences along the Forest Boundary should be reconstructed, where appropriate.

## 4.11.6 Regulations and Direction

Infrastructure will be replaced in accordance with applicable codes and handbooks, such as the Manual for Uniform Traffic Control Devices (for signs) and the Uniform Building Code (for facilities). Resource mitigation measures and best management practices will be incorporated where applicable.

## Appendix A – Photos


**Figure 11-1**. Sula Peak Lookout


**Figure 11-2**. Damaged bearing trees.

**Figure 11-3.** Damaged boundary post.

# 4.12 Recreation

## 4.12.1 Introduction

The Bitterroot Valley is a popular recreation spot for residents of the Bitterroot Valley and Missoula and for tourists traveling on Highway 93. Hunting, fishing, hiking, scenic driving, and camping are just a few of the popular activities. The Bitterroot National Forest has numerous trails that access the Anaconda-Pintler, Selway-Bitterroot, and Frank Church-River of No Return wilderness areas. Day hiking is also a popular activity along the trails that lead into the backcountry. Recently built loop trails outside of wilderness are attracting increasing use.

Forest recreation resources are divided into three categories: wilderness, developed, and dispersed. Most of the use in the Bitterroot Valley is dispersed in nature.

Developed recreation includes campgrounds, picnic areas, the Lost Trail Ski Area, and cabin and lookout rentals. Lake Como Recreation Area, Bass Creek Recreation Area, and Lost Trail Ski Area are the forest's most popular sites. Painted Rocks Reservoir in the West Fork of the Bitterroot River drainage is a popular Montana State Recreation area.

Large roadless tracts, hundreds of miles of open roads, dozens of trailheads, and over 1,000 miles of trails characterize dispersed recreation in the Bitterroot Valley. Large areas of the forest are relatively wild in character, so dispersed recreation can provide outstanding opportunities for solitude. Use of this resource is as varied as the visitors, and range from motorized winter sports activities to primitive wilderness experiences. Trapper Peak offers spectacular views. The East and West Forks of the Bitterroot River are excellent fisheries. The West Fork provides rafting opportunities.

Trails are discussed in Section 5.10. More details on wilderness can be found in Section 5.13.

## 4.12.2 Issues

- How will the fires affect tourism?
- Will the safety of forest users be compromised?
- How did the fires affect developed recreation?
- What effects did the fires have on dispersed recreation?

## 4.12.3 Pre-fire Conditions

The Bitterroot Valley has traditionally been a playground for residents of the communities adjacent to the National Forest, and tourists. In recent years, population growth in the Valley has increased demands for Forest Service facilities and services. Newer facilities, larger crowds, and higher fees have displaced some local users from their favorite developed sites to more primitive dispersed sites.

Lake Como in the Bitterroot drainage and Painted Rocks in the West Fork drainage are large recreation reservoirs within a short drive of most residents of the Bitterroot Valley and Missoula. Boating at Lake Como, and especially the use of personal watercraft (jet skis), has increased dramatically in the past five years. Camping and day use facilities at Lake Como and Bass Creek Recreation areas have recently been upgraded, and this has attracted more non-local use to the site.

Smaller recreation sites are scattered throughout the Valley. Most have traditionally been used by local residents on weekends, but tourists are increasingly using these areas, especially when facilities are modernized. Rombo Campground and Coyote-Coulee trailhead facilities were recently improved. Indian Trees Campground reconstruction was scheduled to start during the fall of 2000 but was postponed due to the fires.

### *4.12.3.1 Recreation Use Trends*

**National trends.** The popularity of outdoor recreation is almost universal. According to a recent survey, 95 percent of all Americans participated in some form of outdoor recreation in 1994-95 (National Survey on Recreation and the Environment, USDA, 1995). This same survey shows a trend of increasing rates of participation in outdoor recreation activities, due to increases in total population and increases in the proportion of people participating in outdoor activities. New activities such as orienteering, rock climbing, caving, and nature viewing are becoming more popular, while traditional activities such as hunting and fishing are declining in popularity.

While demand for recreation opportunities increases, the supply of open space (public lands), and the type of dispersed and primitive recreation opportunities it supplies, is fixed. "Results show effective recreation opportunities decreasing for wilderness, remote backcountry, and extensive undeveloped areas near roads, roaded and partially developed areas, with reductions ranging from 10-36 percent by 2040 nationwide" (English et al, 1993). This study also indicates that the rate of growth is expected to be sharpest for strenuous activities that are trail focused – running, jogging, walking, hiking, bicycling, and cross-country skiing. As baby boomers age, an apparent shift in duration of activity from longer overnight trips to day trips is occurring. Other studies indicate that overall participation in recreation activities has increased by more than 15 percent since 1982. The largest increases include walking for pleasure and fitness,

swimming, sightseeing, and picnicking (Cordell, 1994). Activities that show a decline in participation during the past ten years include hunting, horseback riding, and fishing (National Survey on Recreation and the Environment, 1995). This is consistent with other surveys showing a declining participation rate in consumptive activities while non-consumptive activity participation is rising.

**Regional trends.** Populations in the Rocky Mountain states are predicted to increase 34 percent between 1990 and 2040 (English et al, 1993). This will make states like Montana the fastest growing in the U.S. Demand for open space and recreation will increase proportionally with population increases. The Montana Trail Users Study (McCool and Harris, 1994) indicates that over 70 percent of all Montanans hike or walk for pleasure, and that they prefer backcountry trails for that activity. Day trips, from day hiking to cross-country skiing, are more popular than overnight trips. Bicycling, mountain biking, jogging, horseback riding, cross country skiing, and snowmobiling were all popular activities, with 14-20 percent of the users participating in those activities. A recent report, "Snowmobiling in Montana" (Sylvester, Nesary 1994), indicates that over 12 percent of Montanans participate in snowmobiling. Primitive camping (as opposed to developed site camping) has high participation rates in Rocky Mountain states compared with other regions in the country (National Survey on Recreation and the Environment, 1997).

**Local trends.** The latest U.S. Census Bureau report results indicate that Ravalli County had the highest rate of population growth in the State of Montana during the 1990s. Stevensville and Hamilton top the list of communities with the highest percent growth rate. Stevensville's population increased 70 percent and Hamilton's population increased 66.5 percent. Pinesdale grew by 57.5 percent. Darby grew by 53.8 percent. This increase in population will affect the demands on public lands and increase the number and kinds of recreationists on the Bitterroot National Forest. This increase in resident population, along with expected increases in tourism in the Bitterroot Valley, will add to the pressure for services and facilities.

In 1992, a Bitterroot Forest visitor analysis was completed by the Institute for Tourism and Recreation Research, University of Montana (Hammond and Yuan, 1992). The study focused on visitor travel characteristics and visitor satisfaction levels with various recreation site attributes. Visitors were grouped into "residents" and "non-residents" to segment use patterns and to better understand recreation demand.

- Residents and non-residents both reported that "camping/RV camping" to be their most important activity (24 and 26 percent, respectively)

- Non-residents reported river fishing and socializing (19 percent for both) as second most important activities.

- Residents reported that swimming and picnicking (15 and 12 percent) as their second most important activity

- People reporting day use as an important activity varied significantly between residents (3 percent) and non-residents (7 percent).

Based on national, regional, and local trends, the Bitterroot National Forest can expect a higher than average increase in demand for recreation opportunities, facilities, and services. The Bitterroot Valley, because of its proximity to Highway 93 and relatively large population centers, will experience increasing demands from people seeking opportunities to participate in day use activities such as hiking, walking, horseback riding, sightseeing, boating, and picnicking. Use of the trails in west-side canyons to access the Selway-Bitterroot Wilderness is also likely to increase in the next decade, especially for short duration overnight trips to lake basins along the Montana-Idaho divide.

### *4.12.3.2 Developed Recreation*

**Campgrounds and picnic areas.** Fees are not charged at many Bitterroot National Forest campgrounds during the off-season. All forest districts charge a fee at developed campgrounds during the summer months. The fees range from $4.00 to $14.00. Eighty percent of fees are used for campground upkeep and improvements from the Fee Demo program. Table 12-1 below shows the sites by district, the type of fee collection program, collections for the past two years, and the two-year average.

***Table 12-1. Campground fee data by district***

| Site | Fee program | 1998 collection | 1999 collection | 2-year average income |
|---|---|---|---|---|
| Lake Como Recreation Area (3 campgrounds plus day use area) | Lake Como Fee demo (102) | $34,185.00 | $34,700.00 | $34,443.00 |
| Sula Campgrounds (six campgrounds) | Concession Safety Net #708-11 | $10,630.00 | $10,740.00 | $10,685.00 |
| West Fork Campgrounds (Alta and Rombo Campgrounds) | Regional Campground Fee Demo (106) | $3,340.00 | $4,460.00 | $3,900.00 |
| Stevensville Camp-grounds (Larry Creek and Charles Waters) | Regional Campground Fee Demo (106) | $8,990.00 | $9,300.00 | $9,145.00 |

More detailed information can be found on the Bitterroot National Forest web site at www.fs.fed.us/r1/bitterroot.

**Recreation residences.** There are seven permitted recreational residences on the Bitterroot National Forest. All are on the Sula District in the Warm Springs area.

**Ski areas.** Lost Trail Powder Mountain, located on State Highway 93 at the Montana/Idaho border, operates under a special use permit from the Bitterroot National Forest. The average winter snowfall is over 300 inches.

**Cabin rental program.** The Bitterroot National Forest has two lookout towers and five cabins available through the National Cabin Rental Fee Demo program. Rental prices range from $25 to $50 per night. Restoration of Gird Point Lookout as a rental was scheduled to start during the summer of 2000; most supplies were delivered, but reconstruction has been postponed to the summers of 2001 and 2002. Table 12-2 shows the sites, collection, and the average income for the past two years.

***Table 12-2. Cabin rental program sites, collection, and average income for the past two years***

| Site | 1998 collection | 1999 collection | 2-year average income |
|---|---|---|---|
| D2/D3 Cabin Rentals (Woods, McCart Lookout, East Fork Guard Station, Twogood Cabin, Medicine Point Lookout) | $11,160.00 | $13,700.00 | $12,430.00 |
| D4 Cabin Rentals (Magruder Ranger House, Horse Heaven) | $3,365.00 | $3,620.00 | $3,492.50 |

### *4.12.3.1 Dispersed Recreation*

**Cross-country skiing.** Cross-country skiing opportunities on marked and groomed trails are available on the east side of the Forest at Chief Joseph Pass. During years of heavy snow, cross-country skiing opportunities exist along the low elevation west-side trails, although none are marked or groomed for skiing. Backcountry skiing on the west face of the Bitterroots and in the canyons occurs to a limited degree.

**Hunting.** Day use hunting is one of the primary recreation activities in the Bitterroot Valley. Most of this use occurs during the general deer and elk season. More limited is hunting for mountain lions, upland game, and early-season archery hunting for big game. Most hunters are locals who day hunt from their residences. A smaller but significant number of hunters are non-residents who use outfitters and stay at off-forest lodging. Smaller yet is the number of hunters who camp on the Forest. This use includes end-of-road camps and those who establish backcountry or wilderness camps.

The Bitterroot River area includes Hunting District 260 and is a dividing line between east and west hunting districts. District 260 was the most-used deer unit in the Bitterroot area in past years. Hunting District 240 includes Canyon, Blodgett, Mill, and Sheafman Creeks, and had the second highest deer and elk hunter days in the Bitterroot area in past years. The West Fork of the Bitterroot River drainage includes Hunting District 250, the third most-used deer and elk unit in the Bitterroot area. The East Fork of the Bitterroot River drainage includes Hunting Districts 270 and 211. The former is fourth in

deer hunter days in the Bitterroot area, and has almost double the number of elk hunters of any other district in the area. The Rye Creek, Sleeping Child, and Skalkaho drainages include Hunting Districts 270 and 261.

Concentration of hunting use depends on access. Those areas with little or difficult access receive less pressure than areas that can be reached on public roads. Along the foothills, road access defines the areas of concentrated use. Along the Bitterroot face and canyon areas, trailheads and major trails running east-west dictate use levels.

Most conflict during the hunting season is between motorized and non-motorized users. Hunters that prefer to walk often report that there are fewer and fewer places where one can escape the sound and disturbance of motorized use. There is an increasing frequency of travel restriction violations – motorized users entering areas that are closed to motor vehicles. These closures are often imposed for wildlife security.

Motorized users often complain that because of travel restrictions there are fewer and fewer places to hunt off road with off-highway vehicles. They state that they are being "locked out" of public lands. The intermixed pattern of private and Forest Service land within the assessment area adds to this conflict. More and more private landowners are restricting motorized access across their property, which often is the only access to public lands. This confines the increasing demand for hunting access to a finite land base of public lands.

**Fishing.** The Bitterroot River drainage supports an excellent fishery. The heaviest fished streams are the main stem Bitterroot River, and the East and West Forks of the Bitterroot River. The West Fork receives more fishing pressure than the East Fork because it is floatable by rafts downstream of Painted Rocks Dam. Angling pressure is lighter on the Forest than on the main stem Bitterroot River and its forks. The heaviest used areas on the Forest occur along the larger streams (Skalkaho Creek, Sleeping Child Creek, Westside canyon streams, etc) close to roads, trailheads, and developed recreation sites. Generally, the further you get from roads and trails, the lighter the pressure.

Angling pressure is heavy at some of the headwater lakes. Overall, wilderness streams receive light angling pressure, with some heavier pressure occurring locally in the vicinity of well used dispersed campsites. Well-worn angler trails are common and increasing along the heavily fished sections of the canyon streams. These trails are causing local resource damage (sediment input) in places, but at present do not pose a significant problem for aquatic resources.

**Gathering.** The Bitterroot National Forest does not require a permit for recreational gathering of plants.

**Lewis and Clark Trail bicentennial.** Many visitors who travel through the Bitterroot Valley are following the trail of Lewis and Clark and the Corps of Discovery. The number is expected to greatly increase as the bicentennial of the expedition approaches.

The Lewis and Clark expedition entered what is now the Bitterroot National Forest on September 4, 1805, taking a very difficult route over what is now Lost Trail Pass. The precise trail is unknown, but the rugged mountains, bad weather, and hunger were challenges recorded by the Corps of Discovery. The trail through the Lost Trail area is one of the most disputed parts of their trip through the mountains. One expert calls the route "the single most obscure and enigmatic of the entire Lewis and Clark expedition."

On the morning of September 4, 1805, everything was wet and frozen and the ground was covered with snow. Their trail took them over the crest and down the other side of the mountain range, passing near Indian Trees Campground. After traveling about 12 miles, they met a village of the Salish nation consisting of 33 lodges, about 440 people, and 500 horses. This area is now called Ross' Hole and is north of the Sula Ranger Station. The famous Charles Russell painting, *Lewis and Clark Meeting the Indians at Ross' Hole,* is set here. Lewis and Clark purchased 13 horses from the Salish. On September 6 they continued the journey, traveling northwest out of Ross' Hole and camping along the river just north of present-day Spring Gulch Campground. They traveled north through the Bitterroot Valley until again turning west at Lolo. Ross' Hole and much of the Bitterroot Valley where Lewis and Clark traveled is now private property.

**Mountain biking.** Although the popularity of mountain biking has increased over the past five years, the increase in the rate of use on the Bitterroot National Forest has been modest. Mainline trails leading into the wilderness receive some mountain biking use, but trespass into the wilderness is not a significant problem. Trails closer to Highway 93, such as the Coyote-Coulee Trail and the Lake Como National Scenic Trail, are designated for mountain bikes and receive most of the use. Mountain biking is also popular on Forest roads.

**Off-Highway Vehicle (OHV) use.** Most existing Forest roads within the assessment area are open to OHV use. The exception is roads that have permanent or seasonal restrictions to prevent resource damage or to protect wildlife.

OHV use is increasing, and the demand for trail and backcountry opportunities will increase over the next 5 to 10 years. At the same time, there will be pressure to reduce the number of open roads from non-motorized interests and as mitigation for other management activities. The conflict between motorized and non-motorized use will be a major issue for managers in the next decade.

The Forest Service and Bureau of Land Management are proposing to limit or restrict motorized wheeled cross-county travel on the land administered by the two agencies in Montana. The scheduled release date for the final OHV Environmental Impact Statement is January 2001.

**Outfitters and guides.** Forty-two outfitters operate on the Bitterroot National Forest. Many of them operate forest-wide. Approximately 50 percent of the outfitted use is day-use and the other 50 percent is overnight use. Outfitted activities in the assessment area

include summer trips for sightseeing and fishing, fall and winter hunting, day horseback rides, OHV tours, and sightseeing tours. In 1999, the Bitterroot outfitter-guide program collected $49,200.

**Rock climbing.** Rock climbing is becoming more popular on the Bitterroot National Forest. One reason is that climbing areas are within commuting distance for students at the University of Montana. Popular climbing areas are near Lost Horse Creek and on private land near Kootenai Creek.

**Snowmobiling.** Most opportunities and access for snowmobile use are on the east side of the Forest. Trails go from the Skalkaho area to Lost Trail/Chief Joseph Pass; Skalkaho Pass and South Fork of Skalkaho/Rye/Sleeping Child are popular areas for snow machines. On the west side, snowmobiling occurs along the Lost Horse Road and to a lesser degree in some of the other west side canyons and foothills. The wilderness boundary limits opportunities for long distance travel and loop trips. Some trespass into wilderness occurs, especially during heavy snow years, but it is not a significant problem.

**Trails.** Trail conditions are discussed in Section 5.10.

**Watchable wildlife.** Driving and site seeing are popular activities on the Bitterroot National Forest. Wildlife sightings are common throughout the forest. Mule deer, whitetail deer, elk, bighorn sheep, mountain goat, black bear, mountain lion, moose, and many smaller animals and birds may be sighted. The Sula District has a bighorn sheep watchable wildlife site.

**Water sports.** The West Fork District is a popular river recreation area. Selway River float trips require a reservation and permit from May 15 to July 31. In 1999, the Selway River float special use permits resulted in collection of $6,708 under the Selway Fee demo program.

### 4.12.4 Effects and Implications of the Fires of 2000

The Bitterroot National Forest was completely closed to the public from August 3, 2000 to September 6, 2000. Portions of the forest in the Bitterroot and Rye/Sleeping Child/Skalkaho drainages remained closed through October 5, 2000. Montana State Lands were closed on August 10 and re-opened September 5. Some roads were closed on an individual basis for repair and culvert replacement through most of October. The road repair list was updated daily and posted on the Forest's web site.

A difference this year from other major fire years was the worldwide nature of the news and use of the internet. The Bitterroot National Forest and Travel Montana maintained fire updates on their web sites. The Bitterroot National Forest website had 100,000 hits in two weeks during the fire season. Traffic on the Travel Montana website went from the

usual 100,000 to 250,000 hits in August. Major news organizations broadcast from Hamilton and Darby for three weeks.

Recreation opportunities in the Bitterroot Valley were greatly reduced because of fire danger and closures. Scenic mountain views were obstructed by smoke. Residents could not recreate on public lands, and many non-residents cancelled plans to visit the Bitterroot Valley.

### *4.12.4.1 Tourism*

The total effect of fires on travel and tourism related to wildland recreation is not yet known. Decreased recreational activities affected the service sector (outfitters and guides, hotels, motels, bed and breakfasts), retail trade sector (restaurants and stores), and transportation sector (rental cars and airlines).

Many hotels, motels, and bed and breakfasts in the Bitterroot Valley were filled with fire related business, but they may still have had a revenue loss. Government customers usually pay a reduced rate for rooms and do not pay bed tax. Bed tax is 4 percent of the bill that goes to Travel Montana (Montana Department of Commerce) to promote tourism. The lack of bed tax collection for the summer also may hurt the Bitterroot Valley Chamber of Commerce directly. During the first half of 2000, bed tax collection appeared high enough to qualify the Bitterroot for Convention Visitor Bureau status, resulting in more funding going directly to the Valley. The loss of bed tax during August may postpone designation of the status. Bed tax is reported quarterly, so the July through September numbers will not be available until later this year.

Except for the summer public land closure, no long-term tourism impacts are expected. On the contrary, the national and international attention the Bitterroot Valley received during the fires may increase tourism in future years. Yellowstone National Park set visitation records during the five years after the 1988 fires. Many of those who visited Yellowstone after the fires came specifically to see the recovery. What visitors see, especially in the area from Conner to Sula, will be a mosaic pattern of burned, partially burned, and unburned vegetation. Many tourists, especially those traveling between Yellowstone and Glacier National Parks and those following the Lewis and Clark trail, stay near Highway 93. Volunteers at the Darby District historical interpretive center report that tourists are surprised to see green trees, since the summer media coverage has given them the impression that the landscape is totally black.

Dr. Hayley Hesseln, University of Montana School of Forestry, is conducting a survey on Forest Fires and Your Recreation Use. She started the survey during the summer of 2000 but ironically was shut down because of fires. Results are not available at this time.

### *4.12.4.4 Safety*

The summer's extensive wildland fire activity throughout the Bitterroot National Forest has created hazards forest users may not expect. These hazards include:

- Falling trees, limbs, and/or snags
- Debris in roads, trails, and streams such as rocks, mud, and logs
- Rolling material that was loosened by fire burning out vegetation that previously held the material.
- Holes from burned out trees and roots.
- Failures in trail tread from burned out material beneath the trail.
- Rehab equipment and personnel

Forest users need to consider these hazards when entering burned areas and take appropriate safety precautions, including changing travel plans. Many of these hazards may change daily, especially after rain or snow. Hazard trees will continue to be a problem for years.

### *4.12.4.3 Developed Recreation*

**Cabin rental program.** All rental lookouts (plus Gird Point) were wrapped for fire protection **(Figure 12-1, Appendix A).** Magruder Ranger Station had some water damage.

The most significant effect on the rental program was reduction in use and loss of revenue due to the forest closure. Twogood Cabin and Medicine Point Lookout were closed on and off during July because of the threat of fire. All the Bitterroot Forest rental buildings were closed when the Forest closed on August 3. Renters were given the choice of a refund or holding their reservation deposits until next year. Horse Heaven opened when the forest re-opened on September 6. All other buildings rented for winter use will re-open December 1, 2000. A percentage of fees from cabin and lookout rentals under the Regional Cabin Rental Fee Demo are used for upkeep and improvements. The reduction in collections reduces the funding available for upkeep and improvements. Fee collection is summarized in Table 12-3.

***Table 12-3. Effects on rental cabin fee collection***

| Site | 2-year average income | 2000 collection | Refunds given due to fires |
|---|---|---|---|
| D2/D3 Cabin Rentals (Woods, McCart Lookout, E. Fk. Guard Station, Twogood Cabin, Medicine Point Lookout*) | $12,430.00 | $14,600.00 | $2,795.00 |
| D4 Cabin Rentals (Magruder Ranger House, Horse Heaven) | $3,493.00 | $5,145.00 | $965.00 |

*Medicine Point was first available as a rental in 2000.

Fire will change the experience and access to Medicine Point, McCart, and Twogood. The trails into Medicine Point and McCart burned over. The view from Medicine Point is now a burn mosaic.

Restoration of Gird Point Lookout was scheduled to start during the summer of 2000. Most supplies were delivered but reconstruction is postponed to the summers of 2001 and 2002. The delay in reconstruction of Gird Point Lookout will delay use and fee collection for an additional year. Construction of the Medicine Point parking area was also delayed. Both projects were funded through grants.

**Campgrounds and picnic areas.** Fire damage to campgrounds and picnic areas is discussed under Infrastructure, Section 5.11. The forest closure resulted in a reduction in campground use and fee collections. This reduced the funding available for upkeep and improvements. Fee collection is summarized in Table 12-4.

***Table 12-4. Effects on recreation area fee collection***

| Site | 2-year average income | 2000 collection | Calculated loss |
|---|---|---|---|
| Lake Como Recreation Area (3 campgrounds plus day use area) | $34,443.00 | $25,850.00 | $8,593.00 |
| Sula Campgrounds (six campgrounds) | $10,685.00 | $6,900.00 | $3,785.00 |
| West Fork Campgrounds (Alta and Rombo) | $3,900.00 | $1,700.00 | $2,200.00 |
| Stevensville Campground (Larry Creek and Charles Waters) | $9,145.00 | $3,850.00 | $5,295.00 |

**Campground reservation system.** Warm Springs and Spring Gulch Campgrounds are part of the Campground Reservation System. Reservation fees paid to the contractor by each customer will not be refunded. The Forest Service will probably need to reimburse the contractor for the cancellation fee. The anticipated reimbursement is expected to be under $100.

**Concessionaires.** The Bitterroot National Forest had no concessionaires during the 2000 fire season. The fire season did delay until 2002 the planned 2001 concession contract for the Darby/Sula campgrounds. The Forest has direction to complete the concessionaire package for Sula by 2002 since it was previously under a concession.

**Recreation residences.** No recreation residences were burned on the Bitterroot National Forest. The Warm Springs area was underburned and the trees are still green. The firelines have been rehabilitated. Some brush piles will be burned in spring. Permittees could not use their residences during the forest closure.

**Downhill skiing/snowboarding.** At Lost Trail Powder Mountain, expansion work on the Saddle Mountain lift and work on new runs was delayed by six weeks because of fire and the forest closure. The Twin Creeks Fire threatened Lost Trail from the south early in the season. In August, the Valley Complex (Full Circle Fire) approached from the north and burned the Saddle Mountain area; a spike camp and drop point were located at the base area. The ski lodge and other structures were not directly affected. About 5 acres of hazard trees now exist in the ski area

Even with the delay, it is expected the Saddle Mountain ski lift should be operational for the 2001-2002 season as planned. The view from the Saddle Mountain lift area is now of a burn mosaic. The back side of the Saddle Mountain area is more open because of the high burn severity. Out-of-bounds skiing is not expected to be a problem, since there is no exit other than climbing back up the hill.

### *4.12.4.4 Dispersed Recreation*

**Cross-country/telemark skiing.** The most popular cross-country ski area, at Chief Joseph Pass, had no fire activity. Burned areas will have less downfall and fewer low tree branches, resulting in the possibility of more off-trail use. In areas of high burn severity, more snow will reach the ground instead of being intercepted by tree branches.

**Hunting.** Fires affected the most popular deer hunting districts less than other districts. Hunting District 260, the most popular unit in the Bitterroot area, was unaffected by the fires. The Saloon and Blodgett fires burned in District 240. District 250 was affected by the Razor, Taylor, and Fat fires, and the southwest part of the Valley (Sula) Complex. The Valley and Skalkaho complexes burned in District 270, the least-used deer unit but by far the most popular elk unit. Table 12-5 summarizes this data.

***Table 12-5. Effects on hunting districts***

| Hunting district | Rank by user days | Location | Fires |
|---|---|---|---|
| 260 | 1 (deer) | Bitterroot drainage, along river | None |
| 240 | 2 (deer and elk) | Bitterroot drainage: Canyon, Blodgett, Mill, & Sheafman Creeks; Tin Cup to Lolo Creek | Saloon, Blodgett |
| 250 | 3 (deer and elk) | West Fork drainage | Razor, Taylor, Fat; SW Valley Complex |
| 270 | 4 (deer)<br>1 (elk) | East Fork, Rye, Sleeping Child, Skalkaho drainages | Valley, Skalkaho |

Archery season opened on September 2, when parts of the Forest were still closed. The general elk/deer season occurred from October 22 until November 26. There were no fire-related area closures, but some roads closed for culvert replacement. The fire areas were closed to cross-country travel by motorized vehicles.

Burned areas will have less hiding cover, and may be avoided by big game. During winter 2000-2001, lack of food may result in winter starvation for some animals. See Section 5.4 for more information on game animals.

**Fishing.** Except for the summer public land closure, no long-term fishing impacts are expected. Industries tied to sport fishing may have lost revenue.

**Dispersed camping.** Several popular dispersed camping areas were burned over. Debris and garbage that were hidden by grass and brush are now visible.

**Mushroom harvesting.** Mushrooms often appear in great numbers after forest fires. Recreational mushroom picking is expected to be a popular activity, and there may be conflicts with commercial mushroom gatherers. Commercial gatherers may set up dispersed camps, creating garbage and sanitation problems. See Section 5.6 for more information on mushrooms.

**Lewis and Clark Trail bicentennial.** The exact route the Lewis and Clark Expedition is unknown, but the route probably went near the north runs of the Lost Trail ski area expansion. Fire severity was low in this area. Their trail may have gone through the areas burned at high severity north of Saddle Mountain. The Corps of Discovery also traveled near Indian Trees Campground; low severity burning occurred north of the campground. At Ross' Hole, the fire passed through the meadow in the area of the September 4-5, 1805 and July 5, 1806 campsites. Private property on the south side of the Sula basin was also the site of Sula Complex Fire camp until it was burned over. The hillsides to the east and west also burned. The Expedition followed a trail through the Low Saddle/Sula Peak area, where fires burned intensely. Fires burned through the of the Spring Gulch Campground, and burned one leg off an interpretive sign **(Figure 12-2, Appendix A).** Parts of Clark's return route over Gibbons Pass also burned.

Planning and project time on the Lewis and Clark program were lost due to the fires. Interpretive projects and archeology surveys scheduled for the summer were not completed. The "Lewis and Clark in the Bitterroot Valley" brochure (a partnership between the Bitterroot National Forest and Bitterroot Chamber of Commerce), scheduled for summer printing, was postponed.

Applications for Lewis and Clark Outfitter and Guide use continues to be backlogged and some applications for use may change.

**Mountain biking.** Hazard trees and debris may exist on mountain biking trails. Trail repair issues are covered in Section 5.10.

**Off Highway Vehicles.** OHV many increase in burned areas. On October 13, 2000, the Bitterroot Forest set limits on cross-country travel to help the Forest heal and protect watersheds. All cross-country, off-road travel by motorized vehicles was prohibited within the blackened areas of the Bitterroot National Forest until July 15, 2001. Between now and July 2001, the Forest will monitor blackened areas and review the cross-country travel restriction decision. The closure of trails or areas to motorized off-road travel may reduce the conflict between motorized and non-motorized users.

**Outfitters and guides.** The fires and subsequent land closures affected 40 outfitter and guide operations. The most significant impact was the loss or reduction of late summer clientele. Outfitters have indicated their losses are due to factors such as airplane and shuttle fares, lodging arrangements, food, additional stock and equipment purchases, and refunding deposits. The special use fee is determined by a flat rate or percent of gross, so the Forest Service will not need to issue credits or refunds for lost trips. Revenue received from the fees will be reduced. Substantial portions of four outfitters' permitted areas burned. To help compensate, permitted area boundaries were adjusted. Forest Service permit administration may be backlogged because fire activity was the top summer priority. Fee collection is summarized in Table 12-6.

***Table 12-6. Effects on forest outfitter and guide permit revenues***

| Special use | 2-year average income | 2000 collection | Calculated loss* |
|---|---|---|---|
| Forest outfitter and guide permits | $49,200 | $44,800 | $4,400 |

*Full impacts will not be known until after bill reconciliation (January 1, 2001)

**Rock climbing.** The Saloon fire burned the rock face in the Lost Horse rock climbing area. Fixed anchors and permanent ropes may have been damaged and need to be checked for safety.

**Snowmobiling**. The Skalkaho Pass and South Fork of Skalkaho/Rye/Sleeping Child areas were burned. Chief Joseph and Skalkaho snowmobile trailheads did not burn. Hazard trees may block snowmobile trails. There are no restrictions on snowmobile use in the burned areas, since over-snow travel has little effect on fragile soils. Less downfall and the absence of low tree branches will open areas up for increased off trail use; with less tree foliage, noise will travel further. In areas of high burn severity, tree branches and needles will not intercept snow, so more will reach the ground. Users may travel into areas with higher avalanche potential.

**Trails.** Trail conditions are discussed in Section 5.10.

**Watchable wildlife.** The watchable wildlife signs on the East Fork were not damaged. The photo of two elk standing in the East Fork of the Bitterroot River while the adjacent hillside glows with fire has become world-famous **(Figure 12-3, Appendix A).** The Bitterroot National Forest has received many inquires about the photo.

**Water sports.** Fire-killed trees may pose a safety hazard for river water sports. Fallen trees in rivers may be dangerous to kayakers and rafters. More spring run-off from severely burned areas may produce higher spring water levels. Except for the public land closure, no long-term effects on lake water sports are expected. Industries tied to water sports may have lost revenue.

## 4.12.5 Objectives and Recommendations

### *4.12.5.1 Interpretation*

The important questions are what planning process will be used to evaluate fire interpretation possibilities and what criteria will be used to weed out those that: 1) don't really meet visitor needs; 2) are in the wrong places due to safety or visitor use patterns; 3) are not sustainable from an economic/budget perspective; 4) are not sustainable because the items they interpret will disappear in a few years as vegetation recovers; and 5) would result in sign pollution. Obviously, just because we "could" interpret something doesn't mean it makes good management sense.

The challenge that faces the Forest is to sort out the few key highest priority interpretive projects from an interdisciplinary viewpoint. We need to avoid creating a situation in which each resource specialist in each discipline on each district puts up interpretive signs with different design and quality standards and uncoordinated messages. We also need to make sure we use the right media for each message, experience, and location: brochures, videos, booklets, auto tour routes, self-guided trails, personally conducted walks and talks, exhibits, media releases, workshops, and roadside signs are just a few of the possibilities.

We also need to take a *long-term* view in deciding which stories to interpret. Fire (natural role of, suppression of, living with, rehab of, recovery from, preventing future, fire proofing) may seem like the highest priority this fall, but priorities will shift when public attention returns to the stories that people have always found fascinating: local history and prehistory, wildlife, geology, hunting and fishing, wild and scenic places, etc. An example of this is Yellowstone National Park after the 1988 fires; managers flooded the park with fire related interpretation, but removed most of it within 5 years.

### *4.12.5.2 Management Needs and Opportunities*

The 2000 Bitterroot fire season provides opportunities for public education and interpretation. Communities, service groups, other agencies, and schools can work together to develop and implement the plan.

**Interpretation.** An interpretive plan needs to be prepared, and could contain some of the following aspects.

- Combine fire interpretation opportunities with Lewis & Clark bicentennial (comparing the landscape of today with 200 years ago—a fire history of the trail).
- A brochure specific to the 2000 fire season that includes the Bitterroot fire history map and a fire progression map. Other possible subjects include: succession, fire-dependent biological communities, fire ecology, prescribed burning, etc. Use the same information on the forest web page.
- Campground interpretive programs.
- Interpretive sites at Sula Ranger Station, Blodgett Overlook, Sula Peak (include the Salish tribe in interpretive planning), and Sula elk photo site (possible partnership with highway reconstruction).
- Traveling exhibits for offices on fire and restoration related subjects.
- Frontliner/campground host training.
- Include safety messages.

**Conservation education.** Requests are received daily for a variety of presentations on the fires from local schools, service groups, non-profit organizations and others. Schools are also very interested in incorporating fire ecology, forest management, and local environmental information into existing programs. An education plan could contain some of the following ideas:

- Conservation education programs with classroom and field visits covering succession and fire-dependent biological communities. Project Learning Tree, Project Wild, and established Forest Service fire curricula are already available.
- Tree planting, restoration, and fire prevention projects.
- Request all employees to participate in two conservation education events each year . A downfall of many education events is getting enough help to present programs and supervise students.
- Partner with schools and other conservation education groups.
- Include defensible space programs for landowners.

**Other needs and opportunities**

- Recreational mushroom harvest permit plan.
- Strategy for regulating dispersed camps of commercial mushroom harvesters.
- The Bitterroot National Forest web site became established as a source of information about the forest during the 2000 fire season. Continue to use the site inform forest users. Users can access current press releases and information on interpretive programs, hazards, and trail problems when it is convenient for them.
- Monitor snowmobile use.
- Remove hazard trees at recreation sites.
- Early-season patrols are recommended to clean up garbage and debris that became visible when grass and brush burned.
- Fireproof recreation areas (thinning, fuel breaks, bring fire rings to standard).
- Review and correct dispersed recreation effects on fisheries in riparian areas, especially in the Skalkaho drainage.

## 4.12.6 Regulations and Direction

### *4.12.6.1 Current Forest Plan Direction*

Forest-wide Management Goals:
Provide for the current mix of dispersed recreation by maintaining about 50 percent of the Forest in wilderness, about 20 percent in semiprimitive motorized recreation, and about 30 percent in roaded areas (p. II-4).

### 4.12.6.2 *Recreation Opportunity Spectrum (ROS)*

The Bitterroot Valley includes a wide range of recreation settings, from very primitive in the wilderness to the rural areas between Highway 93 and the National Forest.

The Bitterroot Forest Plan allocates the following ROS settings in the Bitterroot fire areas.

| | |
|---|---|
| Primitive | 583,534 acres |
| Semi Primitive Non-motorized | 227,973 acres |
| Semi Primitive Motorized | 291,785 acres |
| Roaded Natural | 624,024 acres |
| Rural | 30,240 acres |

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# Appendix A. Photos

Figure 12-1. Magruder Ranger Station was protected with barricade gel fire retardent.


Figure 12-2. Recreation sign at Spring Gulch Campground, Sula Ranger District.

**Figure 12-3**. This photo, taken near Sula, quickly spread across the world via the internet. Photo by John McColgan.

# 4.13 Wilderness

## 4.13.1 Introduction

There are nearly 748,000 acres of designated wilderness on the Bitterroot National Forest. In addition, the Forest has areas of *de facto* wilderness that include several roadless areas and proposed wilderness additions. The designated wilderness areas include:

- 41,162 acres of the **Anaconda-Pintler** Wilderness on the upper East Fork of the Bitterroot River
- 513,050 acres of the **Selway-Bitterroot** Wilderness, which straddles the Idaho/Montana border
- 193,703 acres of the **Frank Church-River of No Return** Wilderness at the headwaters of the Selway River and along the Salmon River Breaks.

The relative lack of human disturbance and the protected status of wilderness provide unique opportunities to learn about the natural world. Wilderness provides unique opportunities for research and serves as a baseline for comparison with human-altered systems. Wilderness has many biological values. It is also valued for providing water, air quality, personal and social benefits, recreation opportunities, historic context, and economic benefits. Wilderness serves as an example of "hands off" humility where humans generally do not interfere with nature.

The wilderness areas in the Bitterroot National Forest are very rugged and are characterized by steep slopes and mountainous terrain. Travel in the Anaconda-Pintler is by trail only. Travel in the Selway-Bitterroot is by trail or the Selway River; in the Frank Church-River of No Return, travel is by trail or the Salmon River. Except for private land in-holdings in places along the Selway and Salmon River corridors and jet boat traffic on the Salmon, the area seems natural and wild to most people. Campsites, trails, and in-holdings show evidence of human influence, but for the most part these do not interfere with natural processes or substantially influence the overall wildness of the area. Greater threats to naturally functioning wilderness ecosystems are posed by human-caused fire exclusion and weed introduction.

## 4.13.2 Issues

The wilderness resource has a focus different than other resources managed by the Forest Service. Wilderness is a composite resource with inseparable parts. The central focus of management is on the interrelationship of the whole; isolated management strategies for water, range, fuels, wildlife, vegetation, or recreation are not developed. Rather, one integrated wilderness management strategy must deal simultaneously with the interrelationship between these and all other component parts of the wilderness. This is a holistic approach that is large scale, long-term, and focuses on allowing natural processes to dominate. In fire-dependent ecosystems such as the Northern Rockies, fire is a critical, major part of natural processes and is an integral part of wilderness

preservation. Within this framework the following questions and issues have been identified:

- How can weed infestations be prevented or contained?
- How will human use patterns change?
- How will outfitters and guides be affected?
- How was the East Fork RNA affected?
- Will commercial mushroom picking and motorized travel (both illegal in designated wilderness areas) increase?

## 4.13.3 Pre-fire Wilderness Conditions

Most of the vegetation in the wilderness areas evolved with fire as a natural disturbance process. Fire suppression has led to changes in vegetation composition and structure. The effects of these changes on habitat, water runoff, and fire size, intensity, and severity are substantial in some places and of little or no consequence in others.

High-elevation parts of the wilderness areas historically had a longer fire interval than the lower areas, and were more likely to be within the natural range of variability than lower forests. The historic frequency of fire in the three wilderness areas is discussed in the fire and fuels chapter of this document. Changes in vegetation as a result of fire exclusion are discussed in Sections 5.4, 5.5, 5.8, and 5.9.

Fire starts are generally suppressed in the Anaconda-Pintler. The Selway-Bitterroot and Frank Church-River of No Return both have active natural fire programs, meaning that some fires are suppressed while others are monitored and allowed to burn, depending on factors such as the fire's location and timing. Most wilderness fires were suppressed for several decades in the mid-20$^{th}$ century.

**Outfitters and guides.** Eighteen overnight outfitters operate all or partially in the wilderness areas on the Bitterroot National Forest.

**Noxious weeds.** Currently, weeds are not a major problem in the Anaconda-Pintler. A small infestation of spotted knapweed existed in the Kurtz Flat area before the fires. Small, isolated occurrences of sulfur cinquefoil and Canadian thistle have also been noted.

Weeds are more widespread in the Selway-Bitterroot and Frank Church-River of No Return, though infestations are generally limited to areas near trailheads and adjacent to travel corridors. The Frank Church-River of No Return 1999 weed assessment termed that area "manageable" also. The same could be said for most of Selway-Bitterroot on the Bitterroot National Forest.

Many studies detail the problems that can occur with weed infestations and how natural conditions can be degraded. These issues are not unique to wilderness. More details on noxious weeds can be found in Section 5.7.

## 4.13.4 Effects of the Fires of 2000

### *4.13.4.1 Forest-wide Effects*

As shown in Table 13-1, much of the Anaconda-Pintler on the Bitterroot National Forest burned, and the Blodgett fire affected a small part of the Selway-Bitterroot. Larger sections of the Selway-Bitterroot and Frank Church-River of No Return were burned in the Wilderness Complex fires. The complex also burned vast areas on adjoining National Forests.

***Table 13-1. Wilderness acres burned, 2000***

| Wilderness | Wilderness total acres* | Acres on Bitterroot N.F.* | Acres burned on Bitterroot N.F.** | Burn severity | | Comments |
|---|---|---|---|---|---|---|
| Anaconda-Pintler | 158,656 | 41,162 | 28,264 | High<br>Medium<br>Low | 11,489<br>5,951<br>10,824 | Also burned on Beaverhead-Deerlodge NF |
| Selway-Bitterroot | 1,340,681 | *Total:* 513,050<br>*Montana:* 242,676<br>*Idaho:* 270,374 | 29,297 | High<br>Medium<br>Low | 2,806<br>4,087<br>22,404 | Also burned on Nez Perce and Clearwater NFs |
| Frank Church- River of No Return | 2,373,331 | 193,703 | 33,536 | High<br>Medium<br>Low | 5,367<br>5,395<br>22,774 | Also burned on Payette, Boise, Nez Perce, and Salmon-Challis NFs |

*From FS 383 *Land Areas of the National Forest System*, January 2000
**From Bitterroot BAER GIS metadata

Because fire has at times been allowed to take its natural course, mixed conifer forests tend to dominate the Selway-Bitterroot and Frank Church-River of No Return. The fires of 2000 generally burned in a mosaic burn pattern of mixed severity, and fires often slowed or stopped when they encountered an area burned in a past fire. Most of the Wilderness Complex fires were within or close to the range of natural variability. The Thirty fire is important because it is the first large fire in the middle Selway canyon for many years, and yet it appears to have burned at a low severity appropriate to the pine and Douglas-fir forest type.

The fires of 2000 directly affected twelve wilderness outfitters. Some customers cancelled trips, and the outfitters lost revenue. Camp areas were burned over and trails were damaged by fire. It is too early to tell how the fires affected actual hunting. East Fork Outfitters and Salmon Mountain Outfitters had large portions of their respective areas burned. In both cases, a large portion of the area was severely burned.

The East Fork Research Natural Area partially burned. It has very little human use and virtually no disturbance from natural conditions other than historic fire exclusion.

### *4.13.4.2 Effects on the Anaconda-Pintler*

The Anaconda-Pintler Wilderness, in the upper portion of the East Fork of the Bitterroot, is a cohesive unit on both sides of the river. Most of the Bitterroot part of the Anaconda-Pintler was within a fire perimeter in 2000. This year's fires appear to have compensated for years of suppression. Fires may have been larger and hotter as a result of past suppression; much of the forest is lodgepole pine, however, which often burns in a stand-replacing regime.

Large areas were severely burned, and the overall appearance of several drainages has changed dramatically. Fire burned near the most popular destinations, including Kelly, Ripple, and Hidden Lakes, but the camping areas adjacent to the lakes were not directly affected. The area around Hope Lake burned. The areas used by the East Fork Outfitters burned, including the base camp area near Kurtz Flat and a secondary camp at Buck Ridge Meadows. A popular historic cabin was lost and will be missed by those who enjoyed imagining the lives of those who lived there in the not-so-distant past. Parts of the East Fork and Swift Creek drainages burned intensely, opening up a seedbed for noxious weeds.

### *4.13.4.3 Effects on the Blodgett Area*

The Blodgett part of the Selway-Bitterroot Wilderness fires began at the mouth of Blodgett Canyon. It burned into Mill and Sheafman Canyons to the north and Canyon Creek to the south. The fire was estimated at 11,276 acres; 3,458 acres were in the wilderness area. Because lower portions of the fire were adjacent to homes and private property, suppression efforts were concentrated there. The fire followed a more natural course higher on the slopes and farther up the canyons. The wilderness portion of the fire burned mostly at low severity, with only 300 acres estimated to have burned in the moderate or high category. Because the canyons interface with private property, fire rarely takes its natural course in this part of the Selway-Bitterroot.

A few popular streamside camping and picnicking spots burned. The fires burned no outfitter camps.

### *4.13.4.4 Effects on the Selway-Bitterroot and Frank Church*

Fires in these wilderness areas generally burned at severities that were well within pre-settlement norms for the terrain and vegetation types. The spatial pattern of hot fire was also well within natural ranges. Structure protection was very successful. Over all the fires, severity was 12 percent high, 12 percent moderate, and 76 percent low. Higher proportions of severe and moderate fire occurred in the Hamilton and Lonely fires. Fires were more severe on broad ridges with continuous stands of dense lodgepole, Douglas-fir, and subalpine fir. Fires tended to be of low severity in more open xeric conifer and grassland communities on lower elevation south and west aspects.

The fires were entirely on National Forest lands within these two wilderness areas. No private lands are within the burned area or located so as to be at risk of watershed response to the fires.

Fitz, Thirty, and Three Bears fires burned mostly in open bunchgrass or ponderosa pine/Douglas-fir forest. Low severity fire accounted for 89-97 percent of the burned area in these fires. Considering that some of these areas had not burned in the 120-year period of record, this low burn severity is a welcome indicator of the potential for returning natural fire to these environments.

The Hamilton, Lonely, Throng, and Echo fires included more high elevation lands, and severe burns occurred over 3-24 percent of the burned area of these fires. This compares to 30-80 percent for historic fires of drought years in the Selway sub-basin. Patch size of severe burn averaged 71 acres. This is less than the average patch size of stand-replacement fire delineated for the Selway sub-basin, in which patches averaged 112-335 acres for the years 1889, 1910, 1919, and 1920.

A number of outfitter camps were burned, including the base camp of Salmon Mountain Outfitters at Kim Creek Saddle. Some trails were severely impacted in this area. Other Idaho outfitters on the Bitterroot had fire in their areas but were not significantly affected. Fire did not burn adjacent to camps along the Selway River, nor was the launch site impacted. The four river outfitters' season was completed before the fire season hit with full force.

It has not been possible to field-check all the trails that were burned over. We know that there is not always a correlation between fire severity and trail damage; substantial trail damage sometimes occurs in low severity sections.

## 4.13.5 Implications

### *4.13.5.1 Forest-wide Implications*

Because there were so many large fires in the summer of 2000, suppression activities were focused outside wilderness. As a result, fire followed its natural course in many places within wilderness. The fires changed conditions to varying degrees in all three wilderness areas. Fire is a natural force that has always shaped these landscapes, and the post-fire condition is even more "wild" than it was before the fires. The fires of 2000 put a natural process back into wilderness ecosystems that had been changed by suppression.

**Noxious weeds.** Vulnerability to weed infestation is likely to increase drastically in areas that have been burned over. Where a seed source exists and bare soil has been exposed, weeds could easily gain the upper hand over native vegetation. This is a serious threat to the natural vegetation types that characterize most of the area in all three wildernesses.

Wilderness weed populations have the potential to change the character of wilderness at the watershed scale. According to many scientists, researchers, and managers, invading weeds can alter ecosystem processes, including native plant composition and productivity, hydrology, nutrient cycling, and natural disturbance patterns such as frequency and intensity of wildfires. These changes in turn can impact wildlife, recreational opportunities, and scenic beauty. Obviously, these changes are to be avoided when possible, but particularly in wilderness, where natural conditions are not only a defining quality but also a mandate.

**Recreational use patterns.** Some wilderness recreational use will be displaced. Campsites in burned areas will be temporarily abandoned, and new sites will develop. Use patterns may change.

Wilderness outfitters have had to adjust to fire effects before. In many cases, fire has improved hunting areas and has not caused long-term detrimental effects. In some cases, new camps have had to be designated for short periods of time. The Forest will repair fire-damaged trails. This could provide additional income for some outfitters who may be involved in trail maintenance and/or reconstruction in coming years.

Commercial mushroom picking is illegal in wilderness. Additional law enforcement may be required to prevent commercial mushroom picking.

Fire in forested areas may have removed impediments to motorized travel. The Anaconda-Pintler is more vulnerable to motorized trespass than the other wilderness areas due to its more gradual terrain and the proximity of roads.

### *4.13.5.2 Anaconda-Pintler*

The recreation experience in the Bitterroot part of the Anaconda-Pintler will change as a result of the fires. All the trails in the area pass through miles of burned area and were damaged by the fires. Extensive maintenance and some reconstruction work have already been completed on the main East Fork Trail #433, Swift Creek Trail #170, and Clifford Creek Trail #169. Buck Creek Trail was slated for survey and design in 2000 and reconstruction in 2001. Because of the fires, the survey and design were not accomplished; now added maintenance and reconstruction, including relocation, are needed on this trail. This project is a top priority for 2001.

An excellent view of fire burn patterns up the East Fork and in Swift Creek will be a further attraction for those renting McCart Lookout on the edge of the wilderness.

Fishing opportunities are anticipated to stay good and hunting opportunities will undoubtedly improve in the long run. It is too early to gauge the fires' short-term effects on hunting. The riparian Research Natural Area (RNA) in the lower part of the Wilderness had some patchy fire that will stimulate willow growth in an area already well populated by moose. The vegetative mosaic that already exists there will become more diverse biologically and even more interesting to the visitor.

Weed infestations adjacent to trailheads are a serious threat.

### *4.13.5.3 Blodgett Area*

The fires of 2000 played a fairly natural role in the Blodgett area of the Selway-Bitterroot, creating firebreaks that may allow opportunities for lightning-caused fire to continue to be part of natural processes.

Fire changed the view along the trails, but the extent of the changes is small when compared with those in the other wilderness areas. Trail maintenance and reconstruction have begun in Sheafman, Mill, Blodgett, and Canyon Creek canyons. Further problems may develop over the winter.

Some recreational use will probably move to unburned areas, but there is no indication that people will stop using the canyons because of the fire. On the contrary, many people are fascinated by what fire does and are anxious to investigate the changes wrought by fire and watch the ecosystem's recovery.

Threats from noxious weeds are significant in these canyons. Ample seed sources exist along trails, at trailheads, and from adjacent lands. Trails up the canyons are popular for hiking and horseback riding. These recreation activities often introduce weed seeds to disturbed areas.

### *4.13.5.4 Selway-Bitterroot and Frank Church*

Fires in the Idaho portion of the Selway-Bitterroot and Frank Church-River of No Return further enhanced the role of natural processes and will help move the wilderness landscape closer to a natural diversity of plant community composition and structure. Additional tree mortality is likely to occur as trees weakened by fire and pathogens succumb. The long-term ecological effects will be generally beneficial, with the exception of noxious weeds expanding into fire-disturbed suitable habitat. Short-term watershed effects from damaged trails are detrimental to watershed, fisheries, and wilderness values and will require some intervention to support natural rates of watershed recovery. The Nez Perce historic trail was damaged, and stabilization for watershed protection will also protect the trail's historic value.

Soils have been found to be hydrophobic from just beneath the surface to at least three inches' depth in many areas of moderate to high fire severity. Rainfall penetrates the surface but then moves down-slope in a shallow layer. This is likely to result in more rapid delivery of water to streams, with higher peak flows and, possibly, debris torrents in locations of unconsolidated glacial till and steep drainage headwalls in canyons.

Beargrass re-sprouted and grew three inches within three weeks of being burned. Recovery of other burned understory vegetation is likely to be complete in three to five years. Reestablishment of high elevation forest stands may require up to 30 years, based on observation of nearby burned areas and analysis of historic data.

The recreation experience will change somewhat as a result of the fires. Because of the natural fire program in this area, fire effects are not a big surprise for most visitors. The area is not heavily used and those who do use it are often on extended trips rather than day hikes or short rides. The bulk of the use occurs during hunting season, and most hunters recognize the importance of fire for big game forage. Winter and spring may affect trails in the burned areas in ways that have not been anticipated. The one outfitter's base camp that was damaged was used this hunting season and will not be relocated.

## 4.13.6 Objectives and Recommendations

### *4.13.6.1 Management Needs and Opportunities*

Regardless of whether fires were in or out of what is defined as the natural range of variability, it is appropriate to allow nature to take its course in wilderness (where possible) while correcting conditions created by the human influence of fire exclusion. Rehabilitation efforts such as planting and seeding are not appropriate in wilderness. Therefore no "rehabilitation" activities are proposed for the wilderness. The threat of noxious weeds must be addressed, and trail reconstruction and maintenance will be necessary.

**Noxious weeds.**

- Education efforts need to be stepped up.
- Methods of prevention need to be instituted.
- New weed infestations need to be nipped in the bud whenever possible.
- Treatment and containment strategies need to be developed for existing weed infestations, especially those that threaten nearby burned areas.

**Travel management.** This is an opportune time to look at changes in travel management. Depending on the situation, different scenarios make sense for burned-over trails. The options range from extensive reconstruction, including some relocation, to abandonment and removal of the trail from the system. Most of the burned trails fall in the middle ground. Most need extensive log-out, added drainage, and some tread reconstruction. These needs will continue for several years. Specific recommendations for any potential changes in trail management, both in and out of wilderness, are discussed in Sections 5.10 and 5.12.

**Upper East Fork area.** Continued treatment and monitoring of noxious weeds is critical in this area. Trail corridors will need to be closely watched. Portions of the East Fork and Swift Creek drainages were severely burned, opening up a seedbed for weeds. Trailside areas, campsites, fireline, and helicopter landing spots also need to be monitored for new weed invasion.

**Bitterroot part of Salmon and Selway River drainages.** Trail maintenance and reconstruction will be needed in places for public safety and to minimize watershed impacts from trail failure. Some trail work has already been accomplished. Many of the trail treatments will require additional inventory to develop site-specific designs and contracts that can be successfully implemented.

Noxious weed prevention, inventory, treatment, and monitoring are a high priority. Treatments for stabilization of heritage sites may be recommended pending completion of assessments. Alternate camps for outfitters in this area may be necessary.

### *4.13.6.2 Monitoring and Inventory Needs and Opportunities*

**Inventory.** Areas susceptible to noxious weed infestation need to be identified, and a thorough on-going inventory of weed infestations should be conducted.

**Monitoring.** Long-term noxious weed monitoring will be necessary. The *Frank Church—River of No Return Wilderness Noxious Weed Prevention Plan* details various methods of preventing noxious weed spread in Wilderness.

### *4.13.6.3 Opportunities to Work with Citizens, Agencies, and Research*

Wilderness research needs to be wilderness-dependent, preserve wilderness character, and use methods compatible with wilderness. Opportunities for research are under consideration. The following topics have been suggested to date:

- Changes in use patterns
- Fire effects on whitebark pine
- Effects on the RNA on the East Fork of the Bitterroot (undisturbed riparian areas)
- Noxious weed-related topics
- How previous burns influence fire spread, particularly in the Selway River drainage

## 4.13.7 Regulations and Direction

Management direction for Wilderness is derived from the Wilderness Act of 1964, P.L. 88-577. The parts that are especially relevant for this analysis follow:

- Section 2(c): A wilderness....is hereby recognized as an area where the earth and its community of life are untrammeled by man...retaining its primeval character and influence...protected and managed so as to preserve its natural conditions..."

- Section 4(b): "...each agency...shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character."

In addition to the Wilderness Act, the Wild and Scenic Rivers Act also applies to the Salmon and Selway River Corridors. The Central Idaho Wilderness Act of 1980 also applies to the Frank Church-River of No Return Wilderness.

36 CFR 293.2 emphasizes the necessity of preserving wilderness character. It lists the following objectives: (a) natural ecological succession will be allowed to operate freely to the extent feasible, (b) wilderness will be made available for human use to the optimum extent consistent with the maintenance of primitive conditions, and (c) in resolving conflicts in resource use, wilderness values will be dominant to the extent not limited by the Wilderness Act, subsequent enabling legislation, or the regulations in this part.

The Forest Plan reflects all these laws, wilderness philosophy and policy. Forest Plan management direction for noxious weeds in the Anaconda-Pintler was updated in 2000 before the fire season. It addresses weeds at a programmatic scale. A Record of Decision on noxious weed treatment in the Frank Church-River of No Return was signed in 1999.

# 4.14 Cultural Resources

## 4.14.1 Issues

- The fires of 2000 may have affected cultural sites that have not been inventoried.
- Cultural sites affected by the fires may be at risk of post-fire damage.
- The Forest needs an electronic heritage database to be able to quickly respond to disturbances such as fire and effectively protect cultural sites.

## 4.14.2 Effects and Implications of the Fires of 2000

Many cultural sites are known to exist in the burned areas. Heritage specialists visited most of the previously recorded sites within a few weeks of the fires, assessed damages, and prescribed rehabilitation measures to be carried out by Burned Area Emergency Rehabilitation teams. Within the roughly 170,000-acre area burned at moderate to high severity, however, are an unknown number of sites that have not previously been inventoried. These sites may be subject to a variety of post-fire effects, including flooding, sedimentation, erosion, vandalism, and looting.

The Forest Service is required by law to protect cultural resources located on Forest lands.

## 4.14.3 Objectives and Recommendations

### *4.14.3.1 Objectives*

- Determine the extent and nature of cultural resources in need of rehabilitation.
- Determine damage caused by the fires and post-fire effects and the potential for damage to those cultural resources.
- Determine appropriate measures needed for site rehabilitation.

### *4.14.3.2 Recommendations*

- **Conduct an inventory** of all areas that: 1) were burned at high to moderate severity; 2) have a medium to high probability of cultural sites; and 3) have not previously been surveyed. Medium to high probability sites include, but are not limited to, mountaintops, ridges, saddles, isolated knobs, stream confluences, and flats and benches along streams. Inventory would involve field inspection and formal recording (photography, measurement, mapping, and reporting) or any cultural sites identified. An estimated 15,000 acres need to be surveyed.

- **Design and implement appropriate rehabilitation measures for sites damaged or at risk**, based on the findings of the Forest-wide burn area survey described in Proposal 1. This could include capping or other concealment measures to protect exposed sites from vandalism or looting.

- The Lolo, Bitterroot, and Flathead National Forests have devised a joint **Site Inventory Strategy** (SIS) for cultural resource inventory. The SIS is required by the Region 1 Programmatic Agreement (PA) with the Montana State Historic Preservation Office and by the proposed Region 1 Programmatic Agreement with the Idaho State Historic Preservation Office. These PAs are critical to the successful streamlining of National Historic Preservation Act Section 106 procedures for Forest projects.

- By conducting a 100 percent inventory of the moderate to severe burn areas (not just the areas described under Proposal 1) and comparing the results with the predictive model presented in the SIS, the Forests could take advantage of a valuable opportunity to test the SIS against a new data set in a variety of habitat types. This test would contribute greatly to the analysis of the model's validity.

- Funding of this would largely negate the need to fund the first recommendations.

- **Create a Bitterroot National Forest heritage resource database.** Almost all data is currently hard copy. During and after the fires of 2000, an electronic database would have been invaluable to heritage resource managers, resource advisors, and fire personnel attempting to provide effective protection for cultural sites. Furthermore, the Bitterroot will soon be required to enter heritage data into a national heritage INFRA database, though little funding is currently available to perform the records transfer and associated work. Such a database is essential for effective protection of the cultural resource during fire, rehabilitation, and other situations.

# 5.1 Priority Recovery Work

## 5.1.1 Introduction

Numerous changed conditions, risks, and fire recovery needs now face the Bitterroot National Forest. Each resource topic previously presented in this document identifies a variety of work that represent opportunities and challenges for the Forest to accomplish during the next few years. Due to the extent of the fires and the numerous opportunities and recommendations, it is not reasonable to expect that all of the work identified can be accomplished in the near term. Funding and resources to accomplish the work will likely be sufficient to only complete some portion of the recommendations in the next three to five years, making priority setting necessary. Some of the recommended work is essential in the near term. Other recommendations will also be implemented with time, but are less critical or immediate.

This section of the report is intended to clarify priorities based on what is currently known. Criteria established to set priorities include:

- Achieving Forest Plan Goals and Objectives. The Bitterroot Forest Plan guides all management actions on the Forest.

- Public health and safety protection. Where human safety and property risks are present, greater importance is assigned.

- Restoring or maintaining ecosystem function, including both terrestrial and aquatic resource improvement. Projects that directly contribute to improving ecological integrity, including providing for recovery of threatened, endangered, and sensitive species, are considered very high priority.

- Timing considerations. Some work needs more immediate attention than other work. An example of time critical work is completing reforestation before competing vegetation dominates certain sites (shrubs outcompeting tree seedlings).

- Public desires. Opinions and preferences expressed by those who participated in our community involvement series during the autumn, 2000 are an important source of public opinion. There will be an ongoing dialogue as project land planning proceeds.

- Cooperatively developed projects. Projects that are developed in collaboration with communities will be given priority consideration. More outreach to neighborhoods and communities is needed to increase awareness of opportunities to work collaboratively to accomplish fuel reduction or other shared objectives.

- Financial and Funding Realities. Appropriations from Congress and budgets allocated from higher levels in the Agency will directly influence the extent and types of recovery work accomplished on the Forest.

The Forest has identified five program areas that will be the highest priority for fire response work in the next three to five years. These program areas will provide an integrated and balanced approach to post-fire management that conserves resources, recognizes values, and will hopefully meet a majority of public expectations. The most important and beneficial work based on the above criteria are managing fuels, revegetation, reducing weeds, protecting watersheds, and restoring fire damaged infrastructure including roads and trails.

## 5.1.2 Priority Recovery Work for the Next Few Years

### *5.1.2.1 Fuel Management Priorities*

Fuels should be reduced in priority areas in order to minimize the extent and severity of future fires. The top priority areas for fuel management work are reducing fuel threats and future "uncharacteristic" fire effects in warm, dry forest communities (ponderosa pine and Douglas-fir forest type) and in the vicinity of people and homes.

#### *5.1.2.1.1 Burned Area Fuel Reduction Priorities*

**Burned Wildland Urban Interface Lands**

Reducing fuels in burned areas in the wildland-urban interface is a very high priority. Within the Bitterroot's Fire Management Zone 1 (the wildland urban interface), high and moderate severity burns occurred on approximately 14,000 acres and low severity fire burns total approximately 14,000 acres. High and moderate severity burns killed all or the vast majority of the trees. Low severity fires killed fewer trees, but within areas mapped as low severity, entire stands or patches of trees were lethally scorched. There is great concern that without fuel treatment future fires in these areas will result in significant conflagrations that will result in more widespread damage to homes and private property improvement than occurred in 2000.

**Burned Warm, Dry Forested Habitats**

Warm, dry forested habitats that burned are also a high priority for fuel reduction work. The warm dry forested habitats are sites dominated by dense ponderosa pine and Douglas-fir. Unnaturally high fuel loadings prior to the fires predisposed many of these stands to uncharacteristically hot fires compared to their inherent disturbance regime (Quigley et al., 1999) . Within these plant communities, approximately 10,000 acres outside of wildland urban interface burned high or moderate severity (stand replacing). Approximately 7000 acres experienced a low severity burn (mixed severity to non-lethal

fire effects). Many of these areas will need to be reforested in order to achieve the appropriate species composition, stands dominated by ponderosa pine.

It is important to recognize that much of the burned interface lands discussed above are also in the lower elevation warm, dry habitats. In both areas retaining historic amounts of snags and logs for wildlife and soil organic matter with the option to remove the remainder to capture economic values and reduce fuel loadings is recommended. Guidelines for burned tree retention for wildlife and soil values have been developed and should be incorporated in project level design. The urgency to remove woody biomass is to capture economic value and reduce long-term fire hazard. The urgency comes from removing wood before it decays, becomes less economically feasible to remove, and makes further reductions in fuel loading more expensive to taxpayers (Everett, 1995).

In both the burns interface and warm dry forests, concerns exist about the extent and severity of future fires that may visit the areas burned in 2000. Standing dead trees will pile up on the forest floor if no action is taken to reduce them. Because of our dry climate, these large fuels will not decay rapidly, and will most likely remain on the landscape until it burns again. If that happens, the vast area of heavy fuels would set the stage for even larger fires than occurred in 2000. The effects of such an event on soils, watersheds, fisheries, wildlife, indeed the entire host of ecosystem elements, could be more damaging than experienced this past summer.

We believe it would be poor stewardship to leave such a legacy for future decades and the next generation. Action needs to be taken to break up the continuity of this vast expanse of heavy fuels. Fuel reduction zones would be strategically located along selected Forest Service roads and certain ridges. These zones would utilize natural opening and timbered stands to reduce fire intensity of future wildfires, as well as holding lines for future prescribed fires. These actions could reduce the probability of several key watersheds being adversely impacted at one time.

**How Can We Accomplish the Fuel Reduction Work?**

Fuel management work should be accomplished using the entire range of tools available including service contracts, manual and mechanical methods, and timber sales. In some areas there is an opportunity to use the value of the fire killed trees to finance a portion of the work. An urgency exists to reduce woody biomass based on capturing economic value and reducing long-term fire hazard. The urgency comes from removing wood before it decays, becomes less economically feasible to remove, and makes further reductions in fuel loading more expensive to taxpayers. There is an opportunity to design projects that are cost effective, environmentally sensitive, and, where possible, utilize the wood products market (firewood, sawlogs, houselogs, etc) in order to reduce costs to taxpayers. Appropriated funds could be used where the market for wood products would not generate enough value to finance the work.

We heard from many people in Ravalli County in recent months that they would view it as very wasteful if fire killed trees were not salvaged. Due to the extent of fire-killed trees (around 800 million board feet in the Forest's roaded lands) it would not be possible to salvage harvest a vast majority, nor would it be environmentally appropriate. Neither is it likely that the timber industry could accommodate the work or process this large amount of wood before it deteriorates. However, we believe there is an opportunity to accomplish at least some portion of the above fuel reduction needs using salvage as a tool with greatly reduced costs to taxpayers and the added benefit of providing timber products for people to use.

##### *5.1.2.1.2 Unburned Wildland Urban Interface Fuel Reduction Priorities*

Wildland urban interface lands that did not burn also need priority attention. There is a need to take a proactive and preventive approach to addressing fuel accumulations in interface lands. Fuel reduction work is needed in these areas to reduce the intensity, severity, and subsequent undesirable effects of future fire events.

As stated above, many of the interface lands are also in the ponderosa pine and Douglas-fir forest type, which are recognized to have the most altered stand structures and species composition. Therefore, for many green interface areas there is both a social and an ecological benefit in fuel reduction work.

The geographic areas where green interface fuel treatments are needed, in order of priority are West Face Bitterroot, West Fork north of Painted Rocks Reservoir, West Fork South of Painted Rocks Reservoir, Upper East Fork, and East Side Bitterroot Valley North of Skalkaho Creek.

Areas with the highest population density adjoining the Forest should be given priority. At the Forest scale, the west side of the Bitterroot Valley is therefore the considered the highest priority for interface fuel reduction work. Prevailing winds, heavy fuels, limited access, and population density all point to this area as the communities and neighborhoods most at risk. Bitterroot Landscape Assessment fuel priorities and structure density maps have been used to further identify priority treatments areas on the west side of the Valley.

In the West Fork, the Nez Perce Fork and lower West Fork communities are also at high risk and are a recognized priority. Other more isolated areas of settlements near the Forest boundary such as the Springer Memorial and Bonanza Land neighborhood in the East Fork are also recognized priorities.

There is an opportunity and need to bolster the Forest's defensible space campaign, assist with landowner education, and provide assistance to private land owners to accomplish fuel treatments and structure protection measures on private lands. Similarly, there is a need to improve defensible space around developed recreation sites

and administrative facilities on the Forest. These efforts are also considered high priority in the next few years.

#### *5.1.2.1.3 Fuel Reduction Purpose and Needs*

The above fuel hazard reduction activities within burned areas and unburned wildland urban interface have the following purposes and needs:

Fuel loadings, stand structures, and species composition should be returned to more natural conditions in many stands. In order to reduce future fire severity and the undesirable effects that will accompany them, the desired conditions in interface lands and warm dry forest types are five to fifteen tons per acre of down woody debris, limited ladder fuels, adequate crown spacing, and, where appropriate, ponderosa pine as the dominant tree species.

Fires were more frequent and less severe in historical pine-dominated landscapes prior to fire suppression and the alteration of fire regimes. Today landscapes of historic open pine sites frequently have dense Douglas-fir understories that are outside the historic ranges of variability in tree density and fuel loadings. Following stand replacing fire these same sites are still outside the historic ranges of variability in amounts of snags and fallen trees. Unless dead material is reduced and stands are subsequently managed for historic tree densities, future fuel loadings will remain high for both live trees and dead and down debris, creating the potential for intense future fires. The "reburn" assumption is based on the physics of fire behavior; the greater the amount of available fuel the greater the fire intensity and the difficulty of fire suppression. On sites with burns outside their range of natural variability the potential for natural recovery may be reduced (Everett, 1995).

In ponderosa pine stands and interface areas where stand replacing fire occurred and pine seed sources have been lost, there is a need to reduce fuel risks first, and then complete reforestation. Timing is crucial on these sites because they will be dominated by competing vegetation in the next couple of years, significantly reducing successful tree planting. Reducing future reburn potential is also needed in these areas prior to planting in order to protect reforestation investments.

The potential for severe fires in the wildland urban interface are of concern given the proximity to private land values. There is a need to increase the ability to defend property during future wildfires, and provide for increased safety for firefighters and the public. Considering suppression costs of 2000, it is apparent the cost of fuel treatment would save taxpayers a gret deal of money in the long run.

### *5.1.2.2 Revegetation Priorities*

Re-establishing vegetation in some areas is also considered priority fire recovery work. This work will enhance many resource values including longer term watershed protection, visual quality, wildlife habitat, weed management, and many other ecosystem values. The term "revegetation" includes planting or seeding native trees, shrubs, and grasses.

Tree seedlings should to be planted in burned areas where natural regeneration is not expected to meet species composition and stocking objectives. Priority areas include past regeneration harvest units that burned, burned wildland-urban interface lands, and warm, dry forest habitat types to ensure ponderosa pine dominance. Natural regeneration can be relied on in some areas, particularly in lodgepole pine stands at mid to upper elevations.

Fuel reduction work in some priority reforestation sites should, to the degree possible, be completed prior to planting to protect reforestation investments against future fires. This includes reducing fuels in older (20+ years) burned plantations prior to replanting. Several considerations such as budgets, workload, timing with seedling availability, and competing vegetation regrowth will be factors in how much of this work can actually be accomplished before reforestation must occur.

Seeding grasslands with native grasses may be needed, particularly in those heavily infested with weeds where natural grasses have been suppressed and may not respond adequately following weed control.

Establishing shrubs or trees on sensitive landforms that burned hot and are at increased risk of erosion or mass soil movement is desirable. These areas include stream headlands, steep break lands, and inner valley gorges. Again, priority should be given to areas when natural regeneration will be less successful.

Some formerly forested sites should not be artificially reforested. To do so would "undo" some of the beneficial restoration work that the fires accomplished. The fires stimulated early seral conditions in some habitats that have been in short supply due to fire absence in the 20th Century. Examples include mountain grasslands that have become forested, aspen that has been reduced due to competition from conifers, and riparian shrubs that have been shaded out by mature overstories. These plant communities provide valuable habitat for species such as bighorn sheep and many resident and migratory birds.

The appropriate conifer species should be replanted along high severity stream reaches in Little Blue Joint Creek (3.5 miles) in the Little Blue Fire area, and Cow Creek (1.0 mile), in the Blodgett Fire. Both riparian areas experienced very high severity fire. In Cow Creek, landslide risk is of concern. Along the severely burned sections of Little Blue Joint Creek, conifer seed sources are entirely lost. In all other burned riparian

areas, planting trees should be the exception, and allowing natural recovery is preferred for the reasons stated above. Within the next two or three decades, conifers are likely to shade out and replace most of the shrub-dominated riparian areas that have been created by the fires.

Artificial reforestation is not considered a high priority, in roadless areas. This strategy is based on the limited availability of planting stock, financial considerations, and the vegetation diversity objectives discussed above. One possible exception that needs further study is the lower elevation of roadless area portion of the Blodgett Fire due to its proximity to Hamilton, high visibility, and desired species composition within the ponderosa pine – Douglas-fir forest type.

### *5.1.2.3 Weed, Grassland, and Range Management Priorities*

Burned grasslands and adjacent burned forested stands are now more susceptible to weed infestations. Noxious weeds spread in fire disturbed land, especially where tree canopy cover has been reduced below 40%. The priority will be to reduce noxious weed threats and encourage native vegetation restoration, especially on big game winter range. Clean (weed free) grasslands are especially important on elk and big horn sheep winter range. Grassland areas are particularly noteworthy and important on the east side and southeastern portions of the Forest.

The Forest-wide strategy is to keep weeds out of relatively weed-free areas and contain weeds in currently infested areas. Rehabilitation efforts will be focused on protecting grasslands that are relatively clean and that are now more susceptible to infestations after the fires. Another priority is grasslands that have been infested with weeds but still have a viable native plant community left. These areas exist both within fire perimeters and areas that were not burned. In order to accomplish this work on a scale that is most effective, efficient, and safe, aerial herbicide application using a helicopter is needed. Approximately 2000 acres of grasslands have been identified where the use of aerial herbicide application should be considered. This method has been used on the Lolo National Forest and the Three Mile Game Range and has been found to be highly cost-effective and environmentally safe.

Roadside weed control should also be implemented in and through burned areas, as roads are a major source of weed spread. This work is particularly needed in areas at greatest risk of invasion by new weeds that may have been imported by fire suppression traffic from elsewhere. A rapid control response for new weeds is needed before small populations expand and create a much more significant problem. Similarly, conducting trailside inventory, monitoring, and treatment of weeds in and through burns will be needed.

Aerial photography of burned areas was not available at the time BAER teams conducted their assessments, but imagery is now available. Hazards to structures and private property need to be further delineated using the recent aerial photos. One example is the Cow Creek drainage in the Blodgettt Fire area, which burned hot and has several residences in its lower reaches. The Bitterroot NF should involve other agencies (such as BIRT, NRCS, and DNRC) with flood and landslide hazard identification and notification of those potentially affected.

#### *5.1.2.4.3 Finish Burned Area Emergency Response (BAER) Work*

A significant amount of emergency stabilization work was accomplished during the Autumn of 2000. Due to weather limitations, some work still remains and needs to be completed in 2001. For example, approximately half of the road rehabilitation work identified and approved in BAER plans remains to be completed. Various other important BAER projects still pending are detailed in the Watershed Integrity report.

#### *5.1.2.4.4 Watershed Restoration*

Watershed restoration surveys should be conducted in drainages where watershed integrity is ranked low or moderate and that have more that 25% moderate and high burn severity. Past surveys conducted in these drainages should be re-evaluated due to the changed conditions resulting from the 2000 fires.

The following drainages are considered the highest priorities (numbers in parentheses indicate the percent of the drainage that experienced moderate and high burn severity): Cameron (60%), Lower East Fork (50%), Meadow (46%), Rye (45%), Sleeping Child (44%), Camp (34%), and Slate (33%). Watershed restoration surveys will identify access and travel management needs in the areas inventoried. Laird, Camp, Maynard, and Medicine Tree Creeks in the lower East Fork drainage are high priorities for watershed restoration and potential access and travel management. Particular attention needs to be given to the Robins Gulch Road (Road 56249), stacked road systems in lower Laird Creek and below Bear Creek Saddle in section 15, the Moon Creek drainage, Section 3 in Laird (old roads and skid trails), and Blind Draw (old roads).

Segments of certain roads in the above drainages and others should be gravel surfaced, particularly where roads closely parallel streams. About 63 miles of road that are sediment contributors to streams have been identified for gravel surfacing. Gravel surfacing has been shown to be very effective in reducing sediment from roads. Of that total, about 24 miles are in the East Fork drainage.

Three road segments that closely follow streams in burned areas are chronic sediment producers in low integrity watersheds; the North Fork Rye Road (Road 321), the main Rye Creek Road (Road 75) and the Jennings Camp Road (Road 723). There is an opportunity to transfer use to other road systems located farther away from streams and

to obliterate, recontour, and revegetate the abandoned segments to reduce road sediment input. Relocating Roads 321 and 75 should be considered if ownership issues can be resolved (cost share). If not, apply gravel surfaces. Also consider obliterating two miles of Road 723. This road is a chronic sediment source, and grazing aggravates the problem. Gravel Road 723 if obliteration is not feasible.

#### *5.1.2.4.5 Fisheries Improvements*

Replacing or removing all culverts that act as fish barriers in the burned drainages would benefit fisheries, especially those that are in key bull trout habitat. Site-specific recommendations are provided in the Fisheries report, Section 4.3, of this assessment.

Opportunities to reduce irrigation ditch effects on fisheries should also be pursued. Cooperation with local irrigation districts is needed in order to reconnect fish populations in the Skalkaho and Sleeping Child drainages to the Bitterroot River by retrofitting and screening six existing irrigation diversions for fish passage. Also, removal of the abandoned concrete diversion on private land in lower Sleeping Child Creek would eliminate a key fish barrier. Pursue BAER fish report recommendations to remove weir diversions through use of National Forest System funds on private land through a cooperative watershed restoration plan.

Constructing new woody debris fish habitat structures in several stream reaches that lacked woody debris prior to the fires has also been recommended.

### *5.1.2.5 Roads, Trails, and Infrastructure Restoration*

Restoration of infrastructure damaged by fire is a priority. Damaged infrastructure includes roads, trails, range improvements, recreation facilities, fire facilities, land lines and corner monuments. Road maintenance and reconstruction needs are detailed in Sections 4.2, 4.3, 4.10, and 4.11.

Further analysis is needed to identify trails to retain on the system. For example, the Reimel Creek Trail and Elk Ridge Trail 172, both have relatively low use levels and would require expensive reconstruction and maintenance. Other low use trails where significant work would be needed to restore or maintain them also exist in the Skalkaho Rye area. These and other low use trails need further review and a decision on whether they should be kept on the system and maintained, or dropped from the system.

A great deal of road and trail maintenance will be needed during the next two decades, especially with safety hazard tree removal and clearing downfall on roads and trails. Maintenance work has been identified on 194 miles of trail in addition to the normal trail maintenance workload. Removal of hazard trees around recreation sites is also needed.

Detailed information on road and trail needs is itemized in Section 4.10 of this assessment.

Damaged infrastructure will need to be restored. Damaged recreation signs and structures need to be replaced, as does the burned Sula Peak Lookout and radio repeaters. Most of the 70 miles of range fence and 18 water developments destroyed occurred in the East Fork, and most of these improvements also need to be restored.

Significant damage to posted landlines and monumented survey corners occurred and is a priority to restore. Previously unsurveyed boundaries probably also need to be established to support recovery work.

### 5.1.3 Conclusion

These five priority program areas are intended to provide needed focus for the Forest's program of work for the next three to five years. It is recognized that project level analyses and further study of more specific issues will be necessary to implement much of the needed work. The magnitude of fire restoration needs and the associated complexity of multiple priorities will be a challenge for the Forest for years to come.

### 5.1.4 Literature Cited

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Quigley et al. 1999. The Interior Columbia Basin Ecosystem Management Project: Scientific Assessment. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

# Appendix A. Contributors

**Tami Brewer, USDA Forest Service, Bitterroot National Forest, Public Affairs Specialist**
Tami has a Bachelor of Science degree in Forest Resource Management from the University of Montana. She worked as a Forester for the Bureau of Land Management in Oregon for seven years. She has worked as a Planning Forester on the Bitterroot National Forest for the past five years. Tami contributed to the report by coordinating the community engagement process and authoring the "Public Comment and Opinion" portion of the document.

**Edward Bringenberg, USDA Forest Service, Lolo National Forest, Forester**
Edward graduated with an Associates in Arts and Sciences degree in forestry from Paul Smiths College in New York. He has worked as a Forester for the Forest Service for 25 years. Edward is currently a forester for the Lolo National Forest, and is an advanced measurement specialist for Forest Service Regions 1 and 4.

**Nan Christianson, USDA Forest Service, Bitterroot National Forest, District Ranger and Fire Response Team Leader**
Nan graduated from the University of Montana with a degree in Geology, and has worked for the Forest Service in resource management planning and administration, minerals and geology, recreation, wilderness planning and management, and partnership and community development for over two decades. She is currently the District Ranger on the Stevensville Ranger District, and is the team leader for the Forest's Fire Response Project.

**Jim Fears, USDA Forest Service, Bitterroot National Forest, GIS Coordinator**
Jim has a Bachelor of Science Degree in Botany from Butler University, and a Bachelor of Science Degree in Forest Management from Northern Arizona University. He as worked for the Forest Service for 24 years in forest inventory, silviculture, computer systems management, and Geographic Information Systems. He is currently the GIS Coordinator for the Bitterroot National Forest. Jim contributed to the report by developing database and GIS data sets, and generating reports.

**Judith Fraser, USDA Forest Service, Bitterroot National Forest, Forest Wilderness/Trails Program Manager**
Judith has a Master's of Science degree in Environmental Studies and has worked in a variety of wilderness and trails positions since beginning as a seasonal in Alpine Lakes Wilderness in 1975 on the Wenatchee National Forest. She came to the Bitterroot in 1991 as Anaconda-Pintler Wilderness coordinator for the Bitterroot, Beaverhead and Deerlodge National Forests.

**Frank Guzman, USDA Forest Service, Bitterroot National Forest, Range/Noxious Weed Specialist**
Frank has a Bachelor of Science degree in Rangeland Resources from Oregon State University. He has worked for the Forest Service for 15 years predominately in Eastern Oregon, before coming to Montana in 1998. Frank is currently the Forest range and noxious weed Program Manager on the Bitterroot NF.

**Ron Heinemann, USDA Forest Service, Clearwater National Forest, Hydrologist**
Ron primarily works on forest landslide analysis and evaluating watershed impacts from storm events. Ron has a Bachelor of Science in Geological Engineering and a M.S. in Hydrogeology from the University of Idaho.

**Lenny Hinmann, USDA Forest Service, Bitterroot National Forest, Reforestation Specialist**
Lenny has worked for the Forest Service for 34 years in silviculture and reforestation. He has spent his entire career on the Bitterroot National Forest. Lenny is currently the reforestation specialist for the Stevensville and Darby Ranger Districts.

**Mike Jakober, USDA Forest Service, Bitterroot National Forest, Fish Biologist**
Mike has a Master of Science degree in Fish and Wildlife Management from Montana State University. He has worked for the Bitterroot National Forest since 1991. Mike is currently the Fish Biologist for the West Fork and Sula Ranger Districts.

**AmberDawn Kamps, USDA Forest Service, Bitterroot National Forest, Silviculturist**
Amber has a Master's Degree in Ecosystem Management and a Bachelors degree in Forest Resource Management from the University of Montana. She is a certified silviculturist and has worked for the USDA Forest Service in silviculture for 10 years in North Idaho and Western Montana. She has been on the Bitterroot National Forest since 1999, and is a silviculturist on the Sula and West Fork Ranger Districts.

**Elizabeth Krueger, USDA Forest Service, Black Hills National Forest, Writer-Editor**
Elizabeth has a Bachelor of Science degree in Forest Resources from the University of Minnesota. She has worked for the Forest Service in the Rocky Mountain Region for 11 years in resource management planning, GIS, and environmental compliance. She is currently a planning Forester.

**Carol Lagodich, USDA Forest Service, Bitterroot National Forest, Recreation Specialist**
Carol has a Masters of Science in Environmental Education from Southern Oregon University, a Bachelor of Science degree with a biology emphasis from Southern Oregon State College, and a certificate in Electronic Publishing from the University of Oregon. Carol worked on forests in Idaho, Oregon, and Washington before joining the Darby/Sula Resources and Recreation department in 1999.

**Stuart Lovejoy, USDA Forest Service, Bitterroot National Forest, Planning Team Leader**
Stu has a Bachelor of Science degree in Forest Resources and Hydrology from the University of Minnesota and has completed graduate work in Forest Ecology at the University of California, Berkley. He has worked for the Forest Service for 23 years in timber management, silviculture, planning and fire management. He is currently Resource Team Leader on the Sula and West Fork Districts, Bitterroot National Forest.

**Charlie Miller, USDA Forest Service, Bitterroot National Forest, Assistant Fire Management Officer**
Charlie has worked in the Forest Service fire organization in Montana and Idaho for 24 years as a smokejumper, fire crew foreman, and assistant fire management officer. Charlie is currently the assistant fire management officer for the Darby Ranger District.

**Jim Morrison, USDA Forest Service, Regional Office, Missoula, Staff Assistant for the Forest Service Interregional Ecosystem Management Coordinating Group**
For the last 12 years, Jim has held a variety of planning positions at the National, Regional, and National Forest levels. Jim began his Forest Service career with 9 seasons on helitack and hotshot fire suppression crews.

**John H. Ormiston, USDA Forest Service, Bitterroot National Forest, Wildlife, Fish and Rare Plant Program Manager**
John has a Master's Degree in Forest Science with a major in Wildlife Management from the University of Idaho. He has undergraduate degrees in Wildlife Management and Biology from the Universities of Idaho and North Dakota. He worked as a wildlife biologist with Montana Fish, Wildlife and Parks for 9 years and has been a wildlife biologist on the Bitterroot Forest since 1974.

**Traute Parrie, USDA Forest Service, Bitterroot National Forest, Civil Engineer**
Traute has a Bachelor of Science degree in Civil Engineering (Architecture option) from the University of Wyoming. She has worked for the Forest Service in the Rocky Mountain Region for 16 years as an engineer and NEPA coordinator. She is currently a Facilities Engineer with the Bitterroot National Forest.

**Diann Pipher, USDA Forest Service, Medicine Bow-Routt National Forests, Public Affairs Specialist**
Diann has a Bachelor of Arts degree in Journalism from Metropolitan State College in Denver, Colorado. She has worked for the Forest Service in the Rocky Mountain Region for eight years as a public affairs specialist and fire information officer. Diann helped edit this report.

**Steve Rawlings, USDA Forest Service, Bitterroot National Forest, Bitterroot Interagency Hotshot Crew Superintendent**
Steve has a Bachelor of Science degree in Forest Management from Oregon State University. He has worked for the Forest Service in the Pacific Northwest Region for 16 years as a timber sale planner, timber sale prep crew member, and hotshot crew member. Steve has been the superintendent of the Bitterroot Interagency Hotshot Crew since 1994.

**David Romero, USDA Forest Service, Bitterroot National Forest, Wildlife Biologist**
Dave has a Bachelor of Science degree in Agriculture majoring in Wildlife Science from New Mexico State University. He has worked for the Forest Service in Region 1 for about 5 years as Wildlife Biologist Trainee. Dave is currently the Wildlife Biologist on Sula and West Fork Ranger Districts.

**Joni Sasich, Soil and Watershed Specialist, independent consultant and owner of RESOURCES.**
Joni has a Bachelor of Science degree in Soil Science from Montana State University, is a ARPACS certified Soil Scientist and holds a USDA Forest Service certification in Silviculture. She has nearly 20 years of experience working for the USDA Forest Service as a Soil Scientist; Soil, Range, and Water Program Manager; Hydropower and Special Uses Coordinator; Silviculturist and Watershed Restoration Alliance Project Leader. She contributed to the assessment by providing management recommendations, and participating in public/research involvement activities, by authoring the Soil Integrity and Watershed Integrity chapters, and by compiling the potential landslide hazard and stream response map.

**Evelyn Savochka, USDA Forest Service, Bitterroot National Forest, GIS Support for the Fire Response Team**
Evelyn returned to the Forest Service, after a 17-year absence, in 1983. She has worked in many different areas, all of which necessitated a heavy involvement with computers, and has worked for the Trapper Creek Job Corps, Sula, Darby, and West Fork Ranger Districts. For the past several years she has served as the GIS Coordinator for the Sula and West Fork Districts.

**Kirk Thompson, USDA Forest Service, Bitterroot National Forest, Civil Engineer**
Kirk has a Bachelor's Degree in Civil Engineering from the University of Virginia. He worked for 28 years in various engineering positions for five national forests before retiring in 1997. Kirk contributed to the report by authoring the "Transportation/Trails" section.

Weeds threaten the ecological integrity of wilderness areas. Education efforts should be increased and additional methods of prevention are needed. New weed infestations need to be aggressively controlled while they're still small. Emphasis areas include trail corridors and areas of concentrated use. Treatment and containment strategies need to be developed for existing weed infestations in wilderness lands, especially those that occur near burned areas. Ongoing weed inventory, monitoring, and treatment needs to be maintained in the Anaconda-Pintler Wilderness, especially at Kurtz Flat, Swift Creek, East Fork Trail corridor, and the McCart Lookout. An integrated weeds control program already is in place in the Frank Church-River of No Return Wilderness. There is a need to similarly address weeds in the Selway-Bitterroot Wilderness.

### *5.1.2.4 Soil, Watershed and Aquatics Priorities*

#### *5.1.2.4.1 Storm Patrol*

For the next two years, roads need to be monitored during or soon after rainstorms, and road maintenance needs to be increased. Engineering and hydrology personnel should patrol areas of concern during and following snowmelt and storm events. The objective is to keep road drainage functioning properly so that landslides or severe erosion events are not triggered by culverts and ditches that have become plugged by debris. Areas of most concern are the road systems in the following drainages: Cow Creek, North Rye/Blacktail, Skalkaho, Rye, French Basin east side, French Basin west side, Laird Creek/Lord Draw, Andrews/Maynard, Moonshine/Medicine Tree, Upper Camp Creek, Little Blue Joint, and Overwhich Creek.

#### *5.1.2.4.2 Flood and Landslide Alert*

The State of Montana and the Forest Service have cooperated to develop a weather watch and flood alert system for the most severely burned watersheds in the Bitterroot drainage. Although everyone that lives downstream of a burned watershed should be on alert, the watersheds that we are most concerned about are Sleeping Child Creek, Skalkaho Creek, Cow Creek, Rye Creek, Rogers Gulch, Medicine Tree Creek, , East Fork of the Bitterroot, and East Fork tributaries such as Robbins Gulch, Cameron, Laird Creek, and subwatersheds of Camp Creek..

Until vegetation recovers and begins to stabilize soils, the threat of landslides exists. Landslides have been so infrequent in the past, it is difficult to predict with certainty where they may occur. We have estimated where they could likely occur, based on a worst-case scenario. Landslide prone areas have been mapped. There is, however, very little that can be done to stop landslides. We plan to conduct storm patrol, as discussed above, to keep road drainage functioning properly so that roads do not trigger landslides.

Aerial photography of burned areas was not available at the time BAER teams conducted their assessments, but imagery is now available. Hazards to structures and private property need to be further delineated using the recent aerial photos. One example is the Cow Creek drainage in the Blodgettt Fire area, which burned hot and has several residences in its lower reaches. The Bitterroot NF should involve other agencies (such as BIRT, NRCS, and DNRC) with flood and landslide hazard identification and notification of those potentially affected.

##### *5.1.2.4.3 Finish Burned Area Emergency Response (BAER) Work*

A significant amount of emergency stabilization work was accomplished during the Autumn of 2000. Due to weather limitations, some work still remains and needs to be completed in 2001. For example, approximately half of the road rehabilitation work identified and approved in BAER plans remains to be completed. Various other important BAER projects still pending are detailed in the Watershed Integrity report.

##### *5.1.2.4.4 Watershed Restoration*

Watershed restoration surveys should be conducted in drainages where watershed integrity is ranked low or moderate and that have more that 25% moderate and high burn severity. Past surveys conducted in these drainages should be re-evaluated due to the changed conditions resulting from the 2000 fires.

The following drainages are considered the highest priorities (numbers in parentheses indicate the percent of the drainage that experienced moderate and high burn severity): Cameron (60%), Lower East Fork (50%), Meadow (46%), Rye (45%), Sleeping Child (44%), Camp (34%), and Slate (33%). Watershed restoration surveys will identify access and travel management needs in the areas inventoried. Laird, Camp, Maynard, and Medicine Tree Creeks in the lower East Fork drainage are high priorities for watershed restoration and potential access and travel management. Particular attention needs to be given to the Robins Gulch Road (Road 56249), stacked road systems in lower Laird Creek and below Bear Creek Saddle in section 15, the Moon Creek drainage, Section 3 in Laird (old roads and skid trails), and Blind Draw (old roads).

Segments of certain roads in the above drainages and others should be gravel surfaced, particularly where roads closely parallel streams. About 63 miles of road that are sediment contributors to streams have been identified for gravel surfacing. Gravel surfacing has been shown to be very effective in reducing sediment from roads. Of that total, about 24 miles are in the East Fork drainage.

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